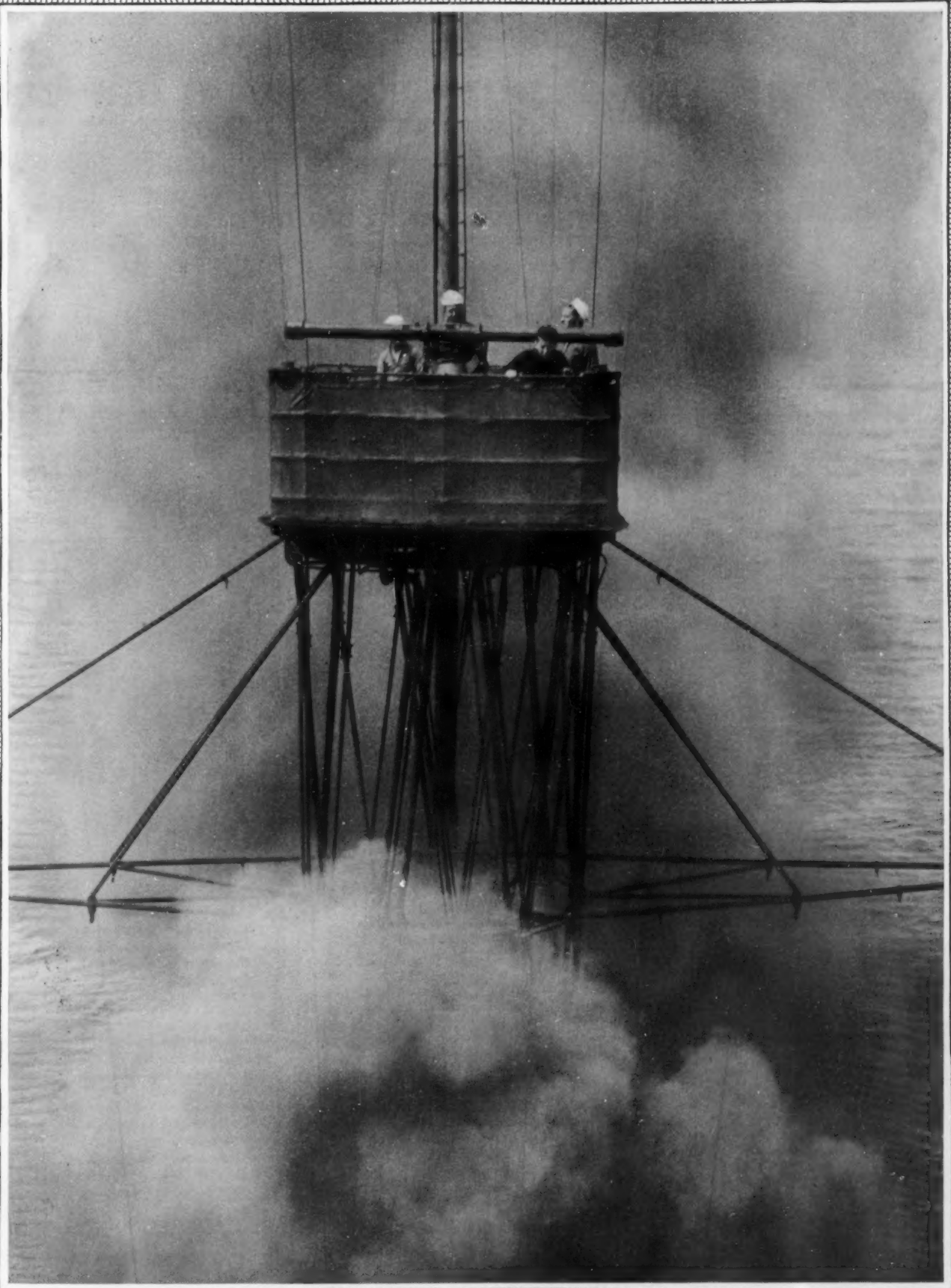
SCIENTIFIC AMERICAN



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February 14, 1914

Munn & Co., Inc., Publishers
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Price 10 Cents
$3.00 A Year

Cadillac

Standard of the World

Public attention is focusing upon one car

and especially upon a principle in that car which distinguishes it from others

Public attention is focusing upon one car, and especially upon a principle in that car which distinguishes it from other cars.

The car is, as you will surmise, the Cadillac; and the principle is its two speed direct drive axle.

Partly because of that principle, the Cadillac rides differently, and, it is said, more luxuriously than most other cars.

The sales arguments of other makers tend to draw public attention in another direction—toward the more conventional types of construction.

And in spite of that powerful influence upon public opinion, in Europe and in America—professional and public interest insists on returning to the Cadillac and its two speed direct drive axle.

This is only logical—it is merely Cadillac history repeating itself, as in the three other memorable cases in which Cadillac progression altered the trend of motor car practice.

The present tremendous interest in the 1914 Cadillac and in the splendid performances of the car can be traced directly to its source.

To begin with, more than 8,500 owners are now driving the 1914 Cadillac.

More than 8,500 people expatiating with unbounded enthusiasm, day after day, upon the unique riding qualities resulting from the latest Cadillac development, are stimulating the keenest interest, even among those driving other cars.

And this process growing and growing in volume, since the first of the new cars appeared last summer, received a pronounced impetus several weeks ago.

The second award of the Dewar Trophy to the Cadillac was an extraordinary endorsement.

Coming from the highest professional tribunal of its kind in the world—the Royal Automobile Club of Great Britain—it confirmed every Cadillac owner in his conviction that there never have been such riding qualities in any car.

That is exactly what Cadillac owners are saying—what the first owner you meet will say to you.

And these two things—the zealous partisanship of more than 8,500 owners rendered still more zealous by the Dewar award—are being accentuated by press comment at home and abroad.

That is why the united volume of attention attracted by other good cars and other good principles of construction have not been able to distract attention from this one car with its peculiar principle.

That is why American and European journalists are venturing to predict that the Cadillac has impressed a fourth indelible imprint upon the industry as a whole.

World-wide interest has been aroused by a plain and indisputable fact—that the sensation of riding in the new Cadillac is almost like the sensation of floating through space.

All the technical and professional discussion in the world will not alter that extraordinary and delightful fact.

THE DEWAR TROPHY

That is why we are impelled to caution you again.

If you wish to guard against disappointment, don't delay ordering your Cadillac.

You have been told the same thing, year after year. And year after year, with an annual increased production, the Cadillac supply has fallen short of the demand.

If the qualities which won the Dewar Trophy—the qualities over which Cadillac owners are so ardently enthusiastic—the qualities which have become a topic of world-wide interest—are qualities worth getting in a motor car—see your Cadillac dealer at once.

Because these qualities are peculiar to the Cadillac.

They flow out of Cadillac standardization, Cadillac methods, Cadillac ideals and the Cadillac two-speed direct drive axle.

It is these qualities, in short, which constitute the Cadillac the "Standard of the World."

STYLES AND PRICES

Standard Touring Car, five passenger	$1975.00				
Seven passenger car	$2075.00	Roadster, two passenger	$1975.00	Inside drive Limousine, five passenger . .	$2800.00
Phaeton, four passenger	1975.00	Landaulet Coupe, three passenger .	2500.00	Standard Limousine, seven passenger . .	3250.00

All prices are F. O. B. Detroit, including top, windshield, demountable rims and full equipment

Cadillac Motor Car Co. Detroit, Mich.

SEVENTIETH YEAR

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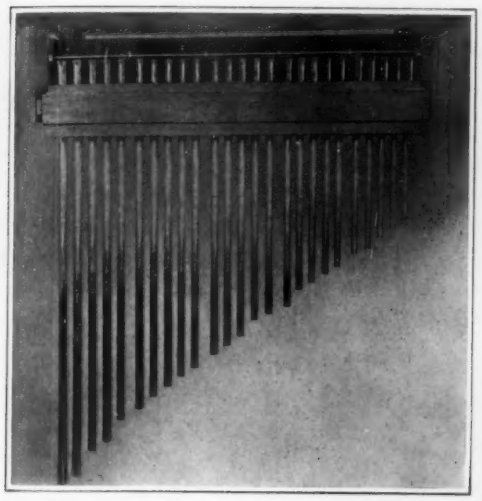
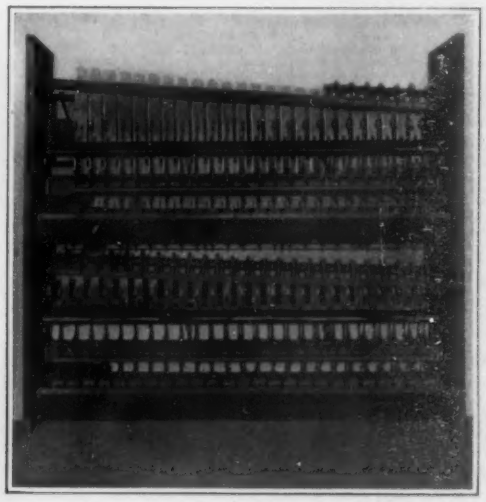
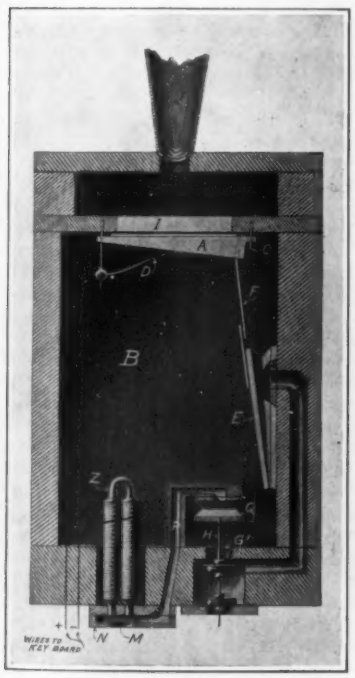


Tubular bells with electric striking mechanism.

Expression box with electrically operated shades.

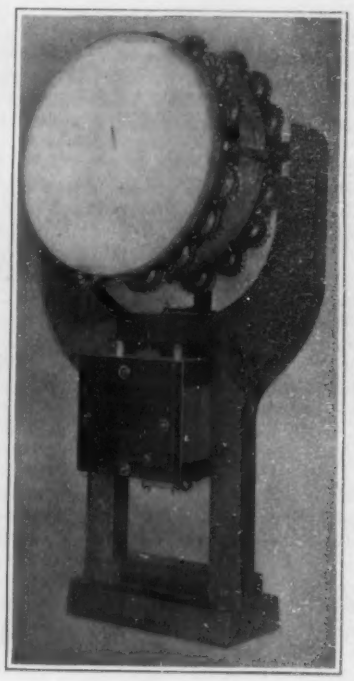


Chrysoglott with electric attachments.



Cross-section of wind chest and electro-pneumatic mechanism.

The inventor seated at movable console. Wind chest with pipes.



Tambourines with vibrating device.

The Hope-Jones Unit Orchestra

By Moritz A. Jägendorf

IT took over twenty-three years to accomplish the work that changed the functions of an organ into that of an orchestra, and yet it appears to be very little when we consider for a moment the result. Thousands have listened to the unit-orchestra night after night in the New York Century theater, in the Cort theater of Chicago, and in perhaps ten more places in different parts of the country; also orders are said to have been received for many more in a number of States. The inventor of this wonderful instrument is Mr. Robert Hope-Jones, the famous electrician and organ builder of England.

Mr. Hope-Jones began his experiments as a hobby, and though it has now become his life work he still looks upon it with the same fondness as the one who does work for sheer pleasure. Naturally, he commenced this work on the organ. He began by placing all the movements in the organ under electrical control. This very soon showed that he could secure an action on the instrument that far exceeded the ordinary movement. But this did not satisfy him. As a musician, he felt that the musical qualities of the organ were not what they might be, and he therefore set out to improve them. Very soon he had a new invention that made possible a finer quality of tone and a larger variety of timbre. This was an apparatus for photographing sound waves in the atmosphere. With photographs of every conceivable instrument in every conceivable variety of tone, it was a comparatively easy matter to reproduce pipes whose notes were, if not exactly identical with those of the original, very near them. And when the percussive instruments that worked in harmony with organ pipes were added, it enabled the player to absolutely control the expression by hand and foot. It was now possible to reproduce the tones of the very finest musicians and the control of the instrument and its rapid action permitted the operator to produce music such as we associate with the very finest orchestras.

Previous to that Barker, an Englishman, had also worked out an arrangement that would control the speech of the organ by means of electricity, and had taken out patents covering his device. He also attempted, two or three times, a practical application of the invention both in England and in France. There were a few other organ builders who made similar attempts, but all of their inventions proved to be unreliable in action and soon fell into disfavor. The electro-pneumatic action invented by Mr. Hope-Jones was absolutely successful and popularized this method of control. It differed from the others, not so much because of a departure from the principle, but on account of the scientific perfection of its details.

On examining the Hope-Jones unit orchestra, there will be found first of all under every pipe, a long rectangular *valve A* set in a chest *B* that is supplied with compressed air furnished by means of a rotary fan driven at a speed of about 1,000 revolutions per minute. These valves are hinged on a pin *C* and are normally kept in their closed position by means of a wire spring *D*, as well as by the pressure of the compressed air in the chamber *B*. There is also a pneumatic bellows *E* so arranged that when closed it will, by means of the arm *F*, open the pallet or valve *A*. Under normal conditions the compressed air in the wind chest finds its way through the passages G^1 and G^2 into the interior of the pneumatic motor *E*, but when the double valve attached to the spindle *H* is raised the passage G^1 becomes closed and the compressed air within the motor *E* escapes to the atmosphere through the passage G^2. The pressure of the air in the wind chest *B* then collapses the pneumatic motor *E*, and by thus opening the valve *A*, allows the compressed air to escape by way of the chamber *I* into the organ pipe *J*.

(*Concluded on page 150.*)

SCIENTIFIC AMERICAN

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

More Information for the House Committee

ASSISTANT Secretary of the Navy Roosevelt, in a recent conversation with half a dozen captains of the United States Navy, asked them which they would rather command in the event of a fight between one "Wyoming" and ten "Oregons." Five of the six said they would prefer to take the "Wyoming." The sixth thought that he would take his chance with the ten "Oregons" because the one "Wyoming" *might* blow up. Now this unanimous choice of the "Wyoming" was made for readily understood reasons. The twelve 50-caliber 12-inch guns of the dreadnought would greatly outrange the old 35-caliber 13-inch guns of the "Oregons;" and the superior speed of the modern ship of 21 knots, as against the present speed of, say, 14½ knots of the "Oregons," would enable the "Wyoming" to maintain a distance of ten or twelve thousand yards, well beyond the effective range of the old 13-inch pieces, and silence or sink the ten "Oregons" one by one, or three or four at a time for that matter.

It is considerations such as these that have led the naval powers to disregard the pre-dreadnought battleship, in estimating the strength of the first fighting line of modern navies; and it was sheer ignorance of these facts that led Mr. Witherspoon of Mississippi in his recent examination of Secretary Daniels before the House Naval Affairs Committee, to make the ridiculous statement that the United States Navy is to-day superior in fighting strength to that of Germany, and also led him, alas! into a discreditable effort to repudiate the Navy Department's estimate of our relative battleship strength and charge our naval officers with having made a deliberately misleading comparison.

The figures of dreadnought strength given in our editorial of December 20th, 1913, on "The Decline of the United States Navy," are perfectly correct. When the ships now building are completed, England will have forty-two dreadnoughts, Germany twenty-six, and the United States twelve. To-day, not even a dreadnought is considered fully available for the first fighting line, unless she has a speed of twenty knots or over, and if, when the ships now building are completed, we can put into our fighting line only twelve such ships against the twenty-six of the German navy, the enormous superiority of their first line of battle is established beyond all question.

In pre-dreadnoughts, we are perhaps more powerful than Germany; but these, in the event of a first-class engagement, would on both sides be held as a reserve; no wise commander-in-chief would put them into the first line of battle, where they would hamper a dreadnought action by their much slower speed, their comparative lack of big long-range guns, and their comparative inability to withstand the gun and torpedo.

Germany could pit twelve dreadnoughts against our twelve and hold in reserve her other fourteen dreadnoughts; which later would enter absolutely fresh into the fight and quickly turn any advantage our fleet might have gained into crushing defeat.

It is best to look facts squarely in the face, and realize, once and for all, that the opposition to warship construction of the past few years in Congress has meant the cutting down of construction at the very time when we should have been most active in meeting the new conditions presented by the evolution of the dreadnought. It is this fatuous policy which has relegated us to the position of a third-rate naval power. Secretary Daniels, in the recent hearing, took a firm stand in favor of two battleships; indeed, if he is correctly reported, he stated that if he believed Congress would make the necessary appropriations, he would be in favor of recommending the construction of four battleships this year.

Bold international policies and an adequate dreadnought fighting line go hand in hand; and at no time were our policies so bold or so fraught with stupendous possibilities as to-day. Consider them: The Monroe Doctrine; the open door in the East; the integrity of China; Asiatic exclusion; and the preservation of the neutrality of the Panama Canal.

Flying Around the World

A FIRST PRIZE of one hundred thousand dollars for a trip around the world in an aeroplane! It seems worth winning. But is it?

An air journey of such length, a journey fraught with undreamed-of perils, may not be lightly undertaken—certainly not without much experimenting. Fifty thousand dollars would be a modest sum indeed to spend in designing, building and testing a machine, capable of flying around the world. Another $50,000 and more would probably vanish in dotting the globe with repair stations and fuel depots, each manned with highly paid mechanics. And so the venturesome aviator would have to content himself with the $50,000 offered by Lord Northcliffe for a trans-Atlantic flight, a prize which he would also win by flying around the world. Even if his expenses were only $100,000, the winning of the Northcliffe prize would seem a wofully small reward for months of arduous preparation and ninety days of grave personal risk.

The Panama-Pacific Exposition directors must surely have realized all these difficulties, and so must the editors of the newspapers who have published yards of printed matter on this romantic proposal. Anyone with but an elementary knowledge of aviation, anyone who has read the difficulties that Védrines encountered in flying to Constantinope (German objections to flying over fortifications, the great wind surf of the Taurus Mountains, the shots of an ignorant, half civilized peasantry) must know that at the bottom of all this talk of flying around the world is a desire for so much free publicity.

Suppose the feat could be performed. What would be the good of it? It would not convince the tired New Yorker that the day is at hand when he may trundle out his monoplane as readily as his automobile and serenely soar off to some sanitarium in the Himalayas, where he may recuperate, thousands of miles from the bewildering attractions of a metropolis. Technically considered, the long trans-European and trans-Mediterranean flights recently made in Europe added only to the newspaper reputation of a few aviators, hungering for applause, but nothing to the technical advancement of the flying machine.

How much might be accomplished with the $300,000 so temptingly dangled in front of the noses of aerial acrobats! A whole aerodynamic laboratory might be built; a wonderful and highly instructive series of much needed experiments might be conducted which would illuminate the dark subject of aerial propellers; an extremely valuable investigation of aeroplane motors might be made, as proposed in last week's SCIENTIFIC AMERICAN. But of all this constructive work, of any true desire to develop the aeroplane so that it may become as safe and sure as the safest and surest of land vehicles—of all these wonderful opportunities not one is seized. Assuming that a supremely self-confident pilot seated at the wheel of a superbly constructed aeroplane, actually circumnavigates the globe, what will the world, the aviator, and the Panama Exposition be able to show for $300,000 spent to make an aviation holiday? Nothing but a battered machine and a battered man.

Early Developments in Naval Gunnery

A COUPLE of hundred years ago almost any ship capable of keeping the sea could be utilized as a man-of-war, and the simplicity of the armaments permitted a ready instruction of crews in the use of their weapons. It was customary, however, to build vessels specially for the purpose of fighting at sea. Ships of the line were constructed to carry heavy armaments and had thick sides to keep out the projectiles of those days. The discussions as to types best adapted for the various purposes of war were just as keen then as now.

In fighting at sea it became customary to fire broadsides, or salvos, in order to permit the smoke to clear away before the next discharge, and to gain the advantage that the shock of the simultaneous impact of many projectiles produced on an adversary. The fighting was necessarily at close range, and positions of advantage were sought. That from which a raking fire could be delivered was the most to be desired, as from such a point a broadside could be opposed by but few guns mounted in the bow or stern of an enemy.

In the many histories of battles and of voyages published in those times, frequent discussion is found of the methods in vogue of gunnery, target practice and tactics, all of which were matters of the greatest interest at a time when fighting was not an unusual feature of a mariner's life. In fact, it would be correct to state that naval gunnery was a matter of greater interest to the public at large at that time than it is to-day.

In an account of Anson's wonderful voyage around the world in 1741-2-3, a description is given of the taking of a Spanish galleon, off the Straits of San Bernardino, while on a voyage from Acapulco to Manila. The author tells of the gunnery methods employed on this occasion to defeat the Spaniards, who were drilled to fire broadsides and to lie flat on deck when expecting a salvo from an enemy. Anson, who was short handed, surprised the crew of the galleon on this occasion, and, greatly to their discomfiture, fired his guns individually and in succession. Picked crews went from piece to piece for the purpose of directing and shooting them, while the guns were loaded by crews organized solely for that purpose. The smooth-bore guns of this period were fired point blank, by means of the slow match and the use of the powder horn.

Rodney's memorable victory of April 12th, 1782, has been ascribed to the flint locks fitted to the guns of the "Duke," out of his own funds, by the captain of that vessel of the previous year. The effective fire of this ship forced the opening of the gap in the enemy's line which so materially contributed to the victory on that occasion.

Shortly after this time "quarter sights" appeared on guns. These were marks engraved on the side of the base ring of the piece. Graduations were in quarter degrees from point blank to an elevation of two or three degrees, and they permitted a rough adjustment for a variation in range.

During the War of 1812 the guns of American vessels were generally fitted with adjustable sights. British authorities of this period have ascribed the successes of their adversaries at sea to this feature, as they themselves had not then adopted those devices, which were considered to be objectionable because of the probability of their fouling the ropes and gear of a sailing vessel, and because of the large port openings made necessary by their use. The "Shannon," at the time of her victory considered to be the best gunnery ship in the British service, was a notable exception to the British rule, and had adjustable sights. During this conflict several actions resulted in American victories because of the fact that our vessels were generally armed with long guns which permitted an accurate fire when our ships were still beyond the range of the shorter weapons of our enemies.

The smoke of the discharge of salvos was a great detriment to rapid gunnery then as now, smokeless powder having diminished but not entirely eliminated this difficulty. In order to overcome this obstacle, and to permit firing when the ship rolled in a seaway with the target close aboard, but shrouded in smoke, an ingenious expedient of utilizing a large pendulum hung in the main hatch was adopted. A system of signals or orders was devised as a part of the fire control scheme by means of which directions were given regarding the proper angle of elevation for the lee guns, or of the depression necessary for those of the weather side, which enabled the guns of the broadside or broadsides that were engaged to be fired when horizontal. This device was also used by the British frigate "Shannon" during the War of 1812-13.

The always highly technical French gunners improved the pendulum idea by checking the indications on this apparatus by means of a reflecting instrument showing the coincidence of the real and reflected horizon at the instant at which the axis of the gun became horizontal.

The advent of the rifled gun, which permitted greater accuracy and penetration of the projectile, was a great step in advance for gunnery as well as ordnance. Iron breech-loading rifled guns for discharging shell were invented in Europe in 1846. The adaptation of breech loading to rifled cannon permitted greater ease, safety, and speed of loading and greatly improved the accuracy of fire, and was another great advancement in the science of gunnery.

Another important stride from the standpoint of ordnance was the invention of the turret. The turret was first given a practical trial on board the "Monitor" (built by Ericsson) in her historic battle with the "Merrimac" at Hampton Roads, and it is distinctly an American contribution to the naval art. The advantages of turrets were that they afforded a good protection and provided a wide arc of fire for the gun. Out of the turret has grown the "dreadnought."

The naval telescope sight, invented by Lieutenant, now Rear Admiral, Fiske, and demonstrated by him at target practice in 1892, was a most important improvement in naval ordnance. The telescopic sight, the range finder and the spotter have made possible the marvelous accuracy of modern long-range shooting.

Engineering

Bering Coal Fails in Test.—Coal taken from the Bering River field in Alaska and tested in the American navy to determine its fitness was a complete failure. This has proved a great disappointment to officials of the navy, who realize that the results of these tests have an important bearing upon the question of the future coal supply of the navy in Pacific waters.

Oil Supply for the Navy.—With only a portion of the fleet equipped to burn fuel oil, the navy is now using 30,000,000 gallons of fuel oil per year, and, according to the Secretary, the time will soon come when the annual amount required will be 125,000,000 gallons. It is proposed to establish tanks at various ports and strategical points; and a special board is investigating the oil lands of the Osage Indians in Oklahoma with a view to their purchase for naval supply.

France to Build 16-Gun Dreadnoughts.—On January 1st, 1915, the French Admiralty will commence the construction of four super-dreadnoughts of about 29,000 tons, which will each carry sixteen 13.4-inch guns in four quadruple turrets. These ships will be able to fire eight guns ahead, eight astern and sixteen on each broadside. The French believe that these ships will be superior to the British "Queen Elizabeth" type, which can concentrate half the number of 15-inch guns in the several directions of fire, or four ahead and astern and eight on each broadside.

Canal Excavation in December.—The grand total of canal excavation to January 1st, 1914, was 215,458,272 cubic yards, leaving to be excavated 16,894,728 cubic yards. The total excavation for the month of December was 1,581,726 cubic yards. In the central division, including Culebra, the total was 860,429 cubic yards, of which 161,000 cubic yards was removed by steam shovels from the top of the banks of Culebra cut in the zone of the slides, in order to relieve pressure, 417,807 cubic yards were taken out of the slides, and 141,000 cubic yards removed by the Culebra sluicing plant.

Perilous Railroad Track.—The Interstate Commerce Commission's report on a derailment on the St. Louis & San Francisco Railroad revealed abominable conditions of the track at the point of derailment. Says the report, the state of the track "was such as to constitute a dangerous menace to the operation of trains in safety." At a rail joint near the point of derailment three spikes were so loose they could be removed by hand, and two rail joints were bolted on one end only. Nine hundred feet east of the point of derailment a rail section was found, under which ten out of the twenty ties were decayed, and a total of thirty spikes were removed by hand from the ties under this rail section alone. Could matters be much worse than this?

Proposed Navy Armor Plant.—The Chief of the Bureau of Ordnance, Rear-Admiral Joseph Strauss, submitted figures to the House Committee on Naval Repairs showing that to build a plant for the construction of armor with a capacity of 16,000 tons a year would cost about $11,000,000. The above-mentioned amount would be necessary if the standard of two additional battleships a year were followed. The witness stated that the construction of this plant would be a wise policy, since it would have the effect of enabling the Government to control the price of armor. Secretary Daniels is of the opinion that there is a "gentleman's understanding" among the armor-plate makers of the world to keep the price up to its present figure of something less than $500 per ton.

Deep Waterway from Montreal to Duluth.—The Government is favoring a discussion, through the International Joint Commission, of the proposal for joint construction by the Governments of the United States and Canada of a deep waterway for ocean-going steamers from Montreal to Duluth, Minn. The matter will be taken up first with the Canadian government. Various routes are proposed, costing from $100,000,000 to $300,000,000. The route favored provides for the utilization of all the lakes and of the St. Lawrence River. Shipment of the products of the Middle West from lake ports to the Atlantic coast and foreign ports, and a similar shipment of return cargoes, would be of vast benefit in reducing rail rates and improving rail facilities from all points to the ports affected.

A Ridiculous Proposal.—We are surprised to note that our staid contemporary, the *Tribune*, devotes nearly half a column to a statement sent "by telegraph to the *Tribune*," in which it is seriously affirmed that a Denver architect proposes to lift the "Titanic" by means of a multiplicity of magnets. A submarine is to be sent two miles down into the depths of the ocean, where it will direct the attachment of "powerful electric magnets" to the hull of the sunken ship. From these magnets light steel cables will lead to wrecking ships two miles above, at the surface. Here steam winches, when all is ready, will proceed to wind up the ill-fated ship and bring her to the surface. We think the technical editor must have been away from this desk when this Denver telegraphic dispatch found its way into print.

Science

An International Conference on Phytopathology is to be held in Rome February 24th, 1914, in accordance with arrangements made by the French government.

Destructive Earthquake in Peru.—An earthquake at Abancay, in southern Peru, on November 7, is reported to have destroyed many villages and entailed a loss of 200 lives.

The Centenary of the Discovery of Iodine was celebrated at Dijon, France, November 9. A commemorative tablet is to be placed on the house in Dijon in which Courtois, the discoverer of this element, was born.

The British Antarctic Expedition of 1914, under J. F. Stackhouse, will have a scientific staff of 40 or more, including two surgeons, two physicists, two geologists, an oceanographer, meteorologist, cartographer, hydrographer and biologist. It has not yet been decided whether wireless telegraphy will be included in the equipment.

The Nobel Literature Prize for 1913 has been awarded to the Indian poet, Rabindranath Tagore. Besides composing Bengali poetry, and his own translations of the same into English, he is a dramatist, historian, philosopher, and musician. One of his plays, "The Postoffice," was produced at the Court Theater, in London, last summer.

The Laws of Porto Rico are now available, in a bulky volume of 1,682 pages, just issued by the Bureau of Insular Affairs of the War Department. This notable work includes a compilation of the revised statutes and codes of Porto Rico, the acts of the Legislative Assembly (i. e., those of a permanent and general character) down to March 9, 1911, together with acts of Congress relating to Porto Rico and the treaty of peace with Spain.

Pictures by Cable.—According to a press report, Prof. Korn, who is well known to our readers as the inventor of the phototelegraph system reports that his invention has been so far perfected that he will be able to transmit messages across the ocean next year. He is planning to send pictures from Europe to New York and from New York to San Francisco at the opening of the Panama-Pacific Exposition.

Prof. Ferdinand Blumentritt, who died at Leitmeritz, Austria, September 20th, 1913, was probably the highest authority of his time on the Philippine Islands. He was so regarded by the Filipinos themselves, and his death is deplored by them as a national calamity; yet, strange to say, his knowledge of the islands was obtained entirely at second-hand, as he never set foot outside of Austria. A monument is to be erected to him in the Philippines.

A Woman Explorer of Arabia.—A Russian woman, Countess Molitor, has just started on an attempt to cross Arabia at its widest part, from west to east, penetrating the desert of Roba'a-el-Khali. This huge desert is absolutely blank on the maps, has never been entered by a European, and is practically unknown even to the natives of adjoining parts of Arabia. The countess proposes to dress as an Arab and to be accompanied only by natives.

Centesimal Division of the Circle.—Most textbooks on trigonometry mention the suggested division of the right angle, or quadrant of a circle, into 100 parts, called "grades," each of which is divided into 100 centesimal minutes, and each of the latter into 100 centesimal seconds. According to the London *Times*, a bill will shortly be introduced in the French Chamber of Deputies to give legality to this substitute for the familiar sexagesimal system.

Sannikof Land, marked with an interrogation point on most North Polar maps, and supposed to lie due north of Kotelnoi Island, in the New Siberia group, was the principal objective point of Baron Toll's expedition in the "Zarya," 1900–1902, which cost the explorer his life. This land has been sighted by several explorers, since it was first seen, at a distance, by Sannikof, in 1811. According to *Petermanns Mitteilungen*, the rediscovery of this island was one of the fruits of Capt. Wilkitsky's (Vilkitskii's) remarkable expedition last summer, the capital achievement of which was the discovery of Nicholas II. Land.

Missing Arctic Expeditions.—Two arctic expeditions which sailed from Russia in the summer of 1912 have now not been heard from for so long a time that grave fears are felt for their safety. One, under Capt. Russanov, after visiting Spitsbergen for the purpose of taking possession of some coal-fields on Bell Sound, attempted to proceed to Nova Zembla, but never reached there, so far as can be ascertained. The other, a large and well-equipped expedition under Lieut. Brussilov, sailed for the Kara Sea, intending to attempt the Northeast Passage to the Pacific, and to make extensive explorations all along the route. Provisions were carried for three years. Wreckage of a ship reported to have come ashore near the mouth of the Pechora River may indicate the fate of one or the other of these expeditions, and a steamer has been sent from Archangel to investigate.

Astronomy

Proper Motion and Distance of the Pleiades.—From a great number of observations it results that all the local groups of stars for which we have the necessary data are found to move in space very nearly parallel to the Milky Way. In each of these groups the parallelism of the movement is such that the parallaxes were determined. For the great majority of the stars they are easily comparable. Thus, for the stars, we know at the same time the position in space and the magnitude direction of linear movement. In investigating the mass of stars known as the Pleiades, they can be clearly divided into two groups, and in each of them the stars are sensibly more feeble than the normal magnitudes in corresponding groups. The question arises: is there dispersion of light in a nebulous atmosphere surrounding the mass of stars? The question is at present very obscure.

High Potential Produced by Radium.—A radioactive substance which emits β radiations should, if isolated, acquire an increasing positive charge until a potential of the order of a million volts is obtained. To verify this Mr. Moseley placed a small vessel containing radium emanation on a piece of quartz in the center of a flask which was highly exhausted. A disk suspended from the neck of the flask by a quartz fiber formed a simple electrometer. It was found that a vessel of 9 millimeters in diameter attained a potential of 160,000 volts in a few minutes. A sudden discharge then took place across the residual gas in the flask. A vessel of 5 centimeters diameter becomes charged much more slowly; there is no discharge, and the final potential, 110,000 volts, is limited by a loss of electricity along the quartz support.

The Emptiness of Space.—When we speak of outer space, the space between star and star, as being empty of matter, it is rather interesting to see exactly what we mean. We know from observations on the planets that light, in its passage across space to our earth, suffers hardly any absorption, and from this fact we can deduce conclusions respecting the density of such matter as exists in outer space. If the degree of rarefaction in outer space is, for example, in the neighborhood of the one hundred millionth part of an atmosphere, then the appearance of Jupiter, for instance, would be as if our atmosphere had twice its present opacity. So that such matter as exists must be in a much more rarefied state. But after all these terms are only comparative. Suppose our atmosphere were allowed to expand up to the limits of the visible universe, as far as the Milky Way, then its rarefaction would be such that it would be quite impossible, by any optical means, to detect the presence of any matter. Nevertheless, there would be about five thousand molecules per cubic centimeter throughout space.

The Existence of the Ether.—The notion of a universal medium, permeating all space, has undergone many vicissitudes. The sphere of celestial fire of the Alexandrians and the interstellar whirlpools of Descartes, gave way to the solid theory which was elaborated with immense skill by Young, Fresnel, Stokes and Kelvin, only to give way to the electromagnetic ether of Maxwell. At the present time there are at least three theories: one considers the ether as an incompressible medium, very rigid and very dense; another considers it composed of particles much smaller than electrons; and the third denies its existence altogether and seeks to eradicate it from the list of physical theories. It is this last theory which gains more and more adherants day by day. We are in a revolutionary epoch; where the tendency is toward explaining phenomena in terms of emission rather than undulation, and of particles rather than fluids. And once more we see reappearing the mysterious and rather terrifying notion of the absolute "nothingness" of outer space which one imagined to be successfully abolished by the introduction of the ether.

Is the Sun Losing Mass?—The work of Einstein on the Principle of Relativity shows that a body which radiates energy loses a portion of its mass depending on the energy radiated. It follows that the sun, which continually radiates energy, is constantly losing mass. M. J. Bosler has calculated that the sun loses a mass equal to that of our earth in thirty million years. If it be assumed that the mass thus lost is gravitational mass it follows that the length of the year increases by six seconds in a million years, and that in the same time the mean longitude of the earth is affected in such a way as to produce a variation of one tenth of a year, i. e., a retardation of thirty-six days in the seasons. Such variations are too minute to be observable. In stellar systems possessing a higher temperature the effect would be much more marked, for the energy radiated by a body varies as the fourth power of its absolute temperature. If, as M. Nordmann believes, there exist stars having a temperature six or seven times that of our sun, their radiation is one or two thousand times as intense. Thus, if the temperature of Algol is 13,800 degrees (Nordmann) it is calculated that at the end of two thousand-years the eclipses of Algol suffer a retardation of about twelve minutes.

The New Curtiss Monoplane Flying Boat

IN the monoplane flying boat designed by Glenn H. Curtiss for Raymond V. Morris of New Haven, features will be found that will be both approved and disapproved.

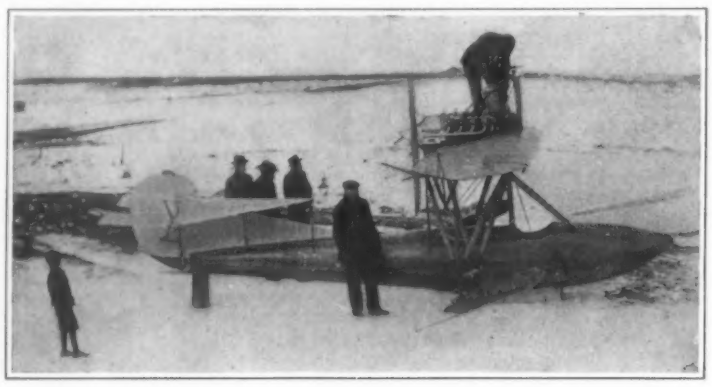
In form the hydroplane hull suggests an expensive imported cigar; big at the end between your teeth, flat part of the way on one side, and tapering gently to nothing at the other end. Its principal dimensions are: length, 22 feet; beam, 30 inches; depth, 36 inches. The bottom, as far back as the step, is the new double V type, found in the new navy boats "C-3," "C-4," "C-5." The bow is pointed instead of square. Two holes in the hull permit the entrance of the pilot and, possibly, of one passenger. The pilot's seat is low, both to give him every protection from the wind, and to bring the shoulder yoke at the greatest diameter of the hull. Unless the pilot sits up very straight only half of his head shows above the coaming.

The wings are set about 40 inches above the hull, attached at the top to the welded steel structure supporting the engine bed, and braced below by struts extending to a cross beam which carries the balancing pontoons.

The design of the wings is not unlike that of the European Etrich machine, and suggests a bird's wings. The idea of placing the engine above the wings has been carried out before, notably in the Santos-Dumont machines. The position of the pilot, with such a weight above his head, is obviously dangerous. The total spread of the wings, from tip to tip of ailerons, is 34 feet. The spread of the supporting surface is 28 feet. For 20 feet in the center the chord is 60 inches, while for four feet at each end the main surface is practically triangular.

Rudder, flippers, and rear stabilizing surfaces follow the lines of those used in standard models of the Curtiss flying boats, modified as to size to fit this smaller machine.

The machine was successfully tried out early in January.



The new Curtiss monoplane flying boat.

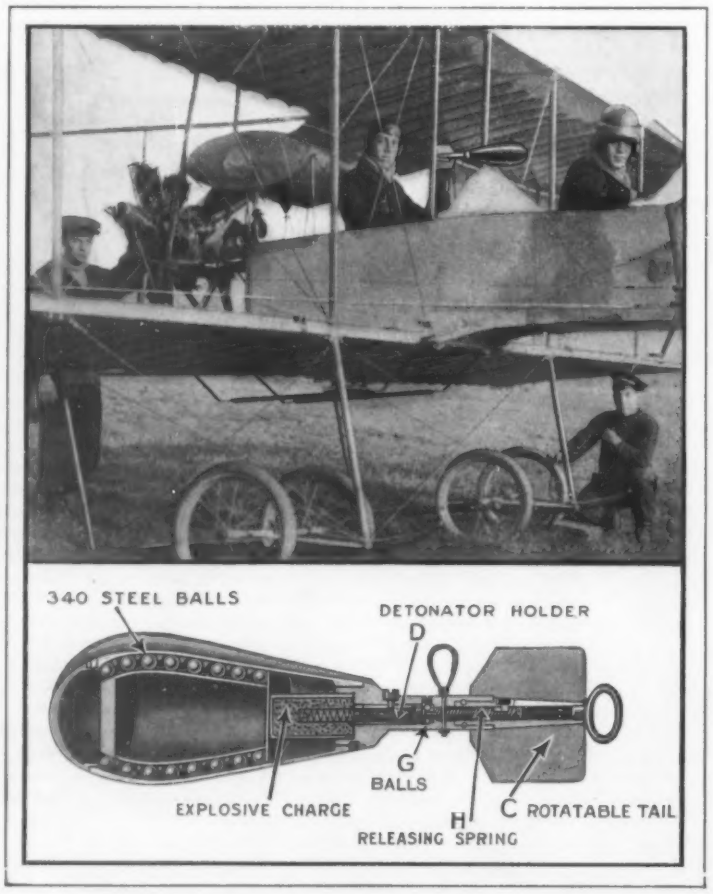
An Aeroplane Bomb That Explodes Only on Striking the Ground

THE new Marten-Hale aeroplane bomb, recently tested in England, has a very simple priming mechanism so that it can be carried in a magazine on board an aeroplane without danger of accidental explosion. Should a bomb be hit while the aeroplane is in flight, or in case the aeroplane descended violently to the ground, by accident or otherwise, it is impossible for an explosion to take place. The bomb can explode only upon making a certain fall through the air and then striking the ground or other obstacle.

At the top the bomb has a tail piece *C* rotatable by the air vanes. The detonator holder *D* is held up away from the main charge by means of its collar and ball-bearing *G* held in place by the projecting end of a screw releasing spindle *H*. When the bomb drops and the spindle rotates through the action of the vanes, it is screwed up until the projection moves away from the steel balls and allows them to fall inward, thus releasing the collar and the detonator. But the detonator still remains off the charge through the spring. When the bomb hits the ground, the detonator falls down on the charge and fires it, exploding the bomb in the customary way. Such bombs can be dropped simply by hand from the aeroplane or can be fired by a spring gun in case a greater velocity is required.

We illustrate a bomb of the shrapnel type, which has a total weight of 20 pounds and carries an explosive charge of about four pounds of trinitrotoluol. It has 340 steel balls, which weigh 5 pounds 12 ounces.

A drop through at least 200 feet in the air is needed in order to cause the rotation of the tail end sufficient to give the release and arm the bomb as we have just seen, and as the firing mechanism is very sensitive, it gives an explosion upon the least impact even on water, mud, snow or the envelope of an airship. The angle of incidence can be as low as five degrees, as it is found. It is found that when dropped in any position from the aeroplane or at any speed of flight, the projectile soon takes the vertical position in falling, so as to hit the ground quite straight and end-on, and there is no tendency to somersaulting or wabbling in the air, which has been a source of trouble in other cases.



An aeroplane bomb that explodes only when it hits the ground.

Curing Noise in a Concrete Building

By E. P. Dorman

WITH buildings of concrete construction used for office purposes noise is often a very annoying feature, more especially so on floors devoted to general offices where large unbroken rooms occur, often sparsely furnished, and having relatively a few people working in them compared with the size of the room.

Under such conditions the sounds produced by people walking about, or shuffling their feet on the concrete floor, by typewriters, or even from talking, are greatly enhanced and echo very badly.

In a four-story building of reinforced concrete construction throughout, erected recently by an industrial corporation, for use exclusively as an administration building, the noise, particularly on one of the floors, was the greatest nuisance, it being at times well nigh an impossibility to hear what anyone said when talking over the telephone, and various expedients were tried during several months in an effort to remedy the trouble, without success. The main room on this floor is flanked on two sides by private offices used by the management, which were separated from the main office by partitions of wood and glass, carried up about eight feet from the floor.

Notices were posted prohibiting whistling, loud talking, slamming doors, etc., which of course reduced the noise from these causes, but still left a good deal that was unavoidable. In another attempt to keep the noise out of the private offices, the partitions were carried clear to the ceiling, which is about 10 feet 6 inches from the floor. This form of partition, however, is by no means soundproof, and concrete floors and ceilings will transmit sound in spite of partitions.

Finally, after various other experiments had been tried, a professor from one of the leading universities, who is an authority on acoustics, was consulted. He advised putting down a square of carpet or a rug in the center of each of the private offices, and one or two in various spots in the main office.

His advice was followed, but in much the same frame of mind that must have been Cinderella's when, after listening to a glowing description of her coach and six horses, she was told to look for a pumpkin and six white mice.

The result in each case was a great surprise, however. The echo from the voice in talking has entirely disappeared, the office force no longer seems to be perpetually shuffling its feet at the desks, and the clicking from eight or ten typewriters, although they are situated on an uncarpeted part of the floor, is markedly subdued. The general sense of quiet is most noticeable, and this in an office through which there is constant passing from one department to another, to be added to the countless other noises that go to make up the general hum of an office.

It would seem that here lies one simple solution of the noise problem that is often advanced as one of the drawbacks to concrete construction for office buildings.

The German Observatory in Spitzbergen

AN account of the recent activities of the Spitzbergen institution, which was called into being by the Zeppelin-Hergesell expedition to Spitzbergen to study conditions with a view to an ultimate airship journey to the pole, is given by its director, Dr. Kurt Wegener, in *Petermanns Mitteilungen*. The observatory is located at Cross Bay, where the little staff of four men have erected their own buildings, viz., a two-story dwelling-house, a small balloon-house, a store-shed, and a rotating pavilion for the kite-winch. Besides the base station, there is a thermometer shelter at the top of the De la Brise Mountain (altitude, 2,000 feet), 4 miles distant, where temperature observations are made throughout the winter. The periodical ascents of this mountain afford an opportunity of observing the state of the sea-ice. An automatic tide-gage and a seismograph are kept in operation. Between June, 1912, and September, 1913, pilot balloons were sent up 270 times to determine the speed and direction of the upper air currents; the maximum altitude attained was over 8½ miles. Observations of temperature and humidity were obtained from 115 ascents of kites and captive balloons, up to a height of nearly 3½ miles. The observatory has a small outfit for wireless telegraphy, which exchanges messages with the powerful wireless station in southern Spitzbergen (this, in turn, being in regular communication with European stations). On one occasion the time signals sent out from the Eiffel Tower, 2,175 miles away, were received directly at the observatory, the longitude of which was thus determined with an accuracy unprecedented in the history of scientific stations in the Arctic regions. Lastly, some remarkable photogrammetric measurements of the altitude and distance of auroras have been made according to Störmer's method. The director of the observatory, with three men from the marble quarries at King's Bay, made a long sledge-journey into the interior in January, 1913, in a gallant effort to carry aid to the unfortunate Schröder-Stranz expedition.

Tokens of Changing China are seen in the immense increase of certain classes of imports into that country. In twelve years the annual consumption of kerosene has increased from 83,579,724 to 197,902,362 gallons, while the importation of lamps and lamp ware has trebled. During the same period machinery imports have increased from $1,000,000 to $3,000,000, with an additional item of nearly $1,000,000 for sewing machines. Matches and match making materials show an increase of over 300 per cent. Imports of clothing, hats, boots and shoes have increased tenfold.

Watching the World Revolve

IT was in 1851 that Léon Foucault ocularly demonstrated that the earth rotates. The occasion was one of historical interest. Foucault sent out invitations which were worded:

"You are invited to witness the earth revolve in the southern hall of the Paris Observatory, to-morrow, at half past two."

Since that invitation was extended, the experiment has been repeated many times. It has been described in the SCIENTIFIC AMERICAN whenever it was performed on a scale at all commensurate with that inaugurated by Foucault himself. Thus, some years ago, Prof. Forbes of Columbia University showed how the earth revolved in St. Paul's Chapel of Columbia University. On that occasion Prof. Forbes himself wrote an article for the SCIENTIFIC AMERICAN, in which the manner of conducting the experiment was described and illustrated.

Recently Prof. H. H. Turner of Oxford University repeated the experiment during the course of some juvenile lectures which he delivered at the Royal Institution. The Royal Institution is so important an organization, and Prof. H. H. Turner so well known an astronomer, that naturally his lecture attracted not a little attention in the public press. Since the subject has thus once more been brought to attention it may not be amiss to set forth the principles of the experiment again.

Foucault suggested that a pendulum so suspended as to be free to swing in any vertical plane would ocularly demonstrate the earth's rotation. That this is so any reader can easily prove for himself. He has only to hold between the thumb and forefinger of one hand a thin cord to the bottom of which a fairly heavy weight is attached. As the weight swings the arm may be moved almost in any direction, without appreciably changing the plane of the pendulum's beat.

In the accompanying diagram let us suppose that *AB* is a straight horizontal rod from which the free pendulum *CD* is suspended in the manner indicated at *C*. Suppose the pendulum to be set swinging in the direction of the length of the rod *AB*, so that *D* remains throughout the oscillation vertically under the rod *AB*. If the rod *AB* be horizontally rotated in the manner indicated by the arrows, it will be found that the pendulum does not follow the rod, but continues to swing in the same plane as before.

It does not matter if the point *B* of the rod is fixed, and if the rod itself is shifted by moving the end *A* horizontally around *B* as a pivot. The pendulum still continues to swing in the same plane. This is true whatever may be the length of the rod. Hence it is clear that the same fixity of the plane of swing will be observed if the rod be shifted horizontally as though forming part of a radial line from a point *E* in its length. In these cases the plane of the pendulum's swing will indeed be shifted bodily, but the direction of swing will still continue in the same plane.

Let *POP'* represent the polar axis of the earth; *ab* a horizontal rod at the pole bearing a pendulum as shown. If the earth is rotating about *POP'* in the direction shown by the arrow, the rod *ab* is being shifted round precisely as in the case previously considered. The swinging pendulum below it will not partake in its motion, and thus, through whatever arc the earth rotates, from west to east, the plane of swing of the pendulum will appear to travel from east to west under *ab*.

A pendulum, however, cannot easily be set up at the pole of the earth. The experiment must be conducted at a more convenient point. Suppose *AB* to be a pendulum-bearing rod, placed (for convenience of description merely) in a north and south position. Then it is clear that *AB* produced meets the polar axis produced (at *E*) and when, owing to the earth's rotation, the rod has been carried to the position A^1B^1, it still passes through the point *E*. Hence it has shifted through the angle *AEA'*, a motion which corresponds to the case of the motion of *AB* (diagram) about the point *E*, and the plane of the pendulum's swing will therefore show a displacement equal to the angle *AEA'*. It will be seen at once that for a given arc of rotation the displacement is smaller in this case than in the former, since the angle *AEA'* is obviously less than the angle *AKA'*. In the latitude of New York a free pendulum would seem to shift through one degree in about five minutes.

It is obvious that a great deal depends on the mode of suspension. In Foucault's original mode of suspension, the upper end of the wire bearing the pendulum was fastened to a metal plate by means of a screw. It might be supposed that the torsion of the wire would appreciably affect the results. In reality, however, the torsion was very small.

It is usually customary to fasten a stylus to the bottom of the bob, which stylus, as the bob swings, plows through a layer of sand on a horizontal table. Spectators find it hard to believe that the pendulum is not swinging round toward the east, but that it is the table itself that is slowly and imperceptibly turning in the opposite direction.

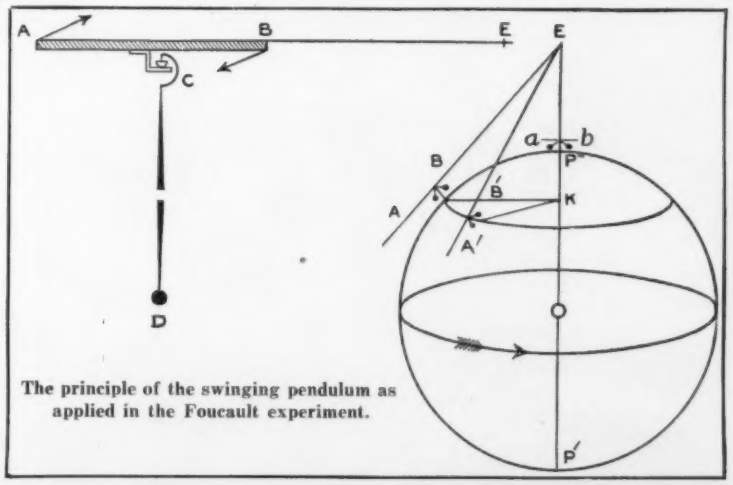
When Foucault made the experiment, he availed himself of the favorable physical conditions of the Panthéon in Paris. His pendulum weighed 62 pounds and was 210 feet long. It is necessary to use a massive sphere. The suspending wire is made as long as possible in order to get considerable linear with small angular displacement. Besides this, when the pendulum is long it swings slowly. This facilitates the readings.

The experiment is most easily understood if it is supposed to take place at one of the earth's poles, say the north pole. Here to an observer the earth would revolve horizontally from west to east. If at the pole the pendulum is set to vibrating in any direction with regard to space, a line drawn on the earth under the ball will rotate around the pole counter-clockwise, and complete its rotation under the plane of the swinging pendulum in 24 hours less 4 minutes (the sidereal day). The movement would therefore be about 15 degrees per hour. The desirability of position for the performance of the experiment diminishes as the equator is approached, at which place it is inoperative. The rule for determining the time of the complete rotation of the ground line is this: Divide 23 hours and 56 minutes by the sine of the angle of latitude where the experiment is being performed. For the latitude of New York city the time would be 36¾ hours. To get the distance the line moves per hour, divide 360 deg. by the time of the rotation of the ground line. For New York city it would be 9.8 deg.

FIRST STAGE
SECOND STAGE
THIRD STAGE
EARTH
AT THE POLES OF THE EARTH THE PENDULUM ANSWERS THE SAME PURPOSE AS DOES THE SMALL HAND OF A CLOCK, BY MARKING TIME

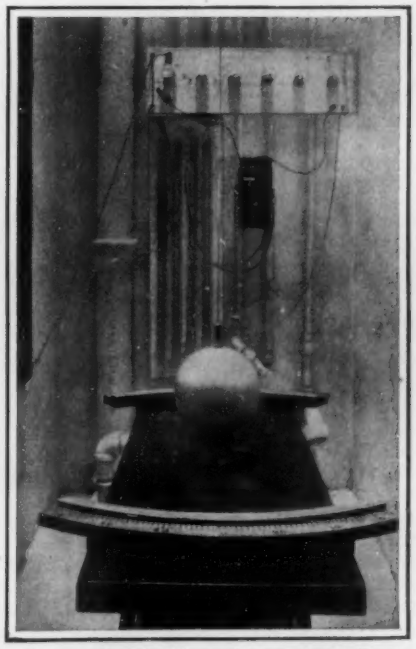
By courtesy of the *Illustrated London News*.

The famous experiment of Foucault.



The principle of the swinging pendulum as applied in the Foucault experiment.

The pendulum is usually started by burning the thread. The pendulum is brought to rest by gravity and resistance of air.



In repeating the Foucault experiment Prof. Forbes used an electrical device to keep the pendulum vibrating for any time.

The Only Lacrosse Stick Factory in the World is located at Cornwall, Ontario, according to a consular report from that place. The game originated in that region, and the Indians thereabout have special skill in whittling the handles of the sticks. The factory employs ten Indians, most of whom will work only in winter. Three fourths of the product is consumed in Canada, the rest going to the United Kingdom, Australia, and New Zealand, except about one per cent which is sent to the United States—principally to the Carlisle Indian School and Ithaca, N. Y. About $2,000 worth of hickory wood for the sticks is annually imported from the United States, while the gut comes from England.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

What Machine Has Displaced the Greatest Number of Men?

To the Editor of the SCIENTIFIC AMERICAN:

We would like to have the name, or some slight information, regarding the machine or machines which has displaced the greatest number of men, and where we would be most likely to see one.

We have been told that it is a shoe machine, but as we want to know for business purposes, must have authentic knowledge, and we know your word is final.

Your favor in this matter will be greatly appreciated.

Philadelphia, Pa. J. J. GEISINGER COMPANY.

[The question here raised is most interesting. Perhaps our readers will let us have their views.—EDITOR.]

The First Wireless Time Service

To the Editor of the SCIENTIFIC AMERICAN:

In my article on the wireless time service of Beloit College, which was published in the issue of January 24th, the claim was made that it was the first of its kind in this country. Since writing that article it has come to my notice that the United States Navy has been operating such a service since 1905 and should, therefore, be given full credit for being the pioneer in the field, not alone in this country, but in the world. It is all the more a pleasure to acknowledge the priority of the Navy because in that early day radio-telegraphic appliances were by no means so well developed as at present. E. A. FATH.

Beloit, Wis.

How to Fly Across the Atlantic

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of December 27th, 1913, Mr. Henry Harrison Suplee gives his ideas of "How the Atlantic could be most easily crossed in an aeroplane." Others in Europe have suggested different routes, but never have I seen suggested the route I am going to mention, and that seems to me the most practicable because of the short stages of the trip and of the weather conditions.

	Kilometers.
Tarfaya, west coast of Africa, to Lanzarote Island (Canary route)	150
Lanzarote to Funchal (Madeira)	470
Funchal to San Miguel (Azores)	800
San Miguel to Fayal (Azores)	290
Fayal to Santa Cruz (Azores)	260
Santa Cruz to St. John (Newfoundland)	1,800
	3,770

The distances are approximate.

The longest distance, 1,800 kilometers, could be divided in two stages by having a station ship located midway.

Aeroplanes will easily speed at 60 miles an hour (96 kilometers); then the longest stage (900 kilometers) would be covered in nine and one half hours. This has been made before.

By making several stops at the Canaries, Madeira and Azores islands, the stages could still be reduced in length.

Mr. Harrison Suplee's suggestion of a northern route would freeze any aviator traveling at the rate of 60 miles an hour. J. ARMENDAIZ.

Alpine, Tex.

[Our correspondent forgets that the Atlantic would be crossed at a height well above 2,000 feet, and that at great altitudes there is little difference in temperature between the frigid and torrid zones of the earth.—EDITOR.]

The Zuider Zee and the East River

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Hiehl's article on the partial draining of the Zuider Zee in your issue of January 24th, naturally appealed to me with unusual interest, seeing that it was after reading an account of this same gigantic project in *McClure's Magazine* of October, 1903, by Mr. Walter Wellman, that the idea occurred to me of filling in the East River by the application of the same method of engineering as that proposed in Holland; my proposal being contained in a letter which appeared in the SCIENTIFIC AMERICAN SUPPLEMENT of July 9th, 1904. Quite recently I have seen it stated that a plan to obliterate the East River was first made some fifty or sixty years ago, but up to the present I must confess to being unable to verify this very broad and indefinite assertion. Perhaps, however, some reader of your paper may be in a position to throw light upon the point in question, and to say who originated the plan, besides giving the actual date and means to be employed.

It certainly argues much for the forethought, resolution, and enterprise of the Dutch character that a work of such unparalleled dimensions and difficulties as the reclamation of the Zuider Zee should have been at length decided on by the States General. Whether in like manner the project of turning the East River into dry land will be adopted is a problem that perhaps will be reserved for a future generation of Americans. At any rate, it has found much favor during the last ten years with several noted engineers, as repeated articles in the New York press during that time bear testimony.

New York city. N. W. STILL.

Arrangement of Magneto Magnets

To the Editor of the SCIENTIFIC AMERICAN:

In reading the account of your associate editor's trip through the Ford Motor Company's factory, in the SCIENTIFIC AMERICAN of January 8th, on page 9, column 3, lines 8, 9, and 10, I note the following error in stating the method of placing the magnets in trays:

"With the north pole of one magnet touching the south pole of the next adjacent magnet, and so on."

This should read, "with the north pole of one magnet touching the north pole of next adjacent magnet, and south pole of same magnet touching south pole of next adjacent magnet, and so on." The magnets should be placed in tray so as to have no attraction for each other. Thus the two north poles constitute a positive pole in the magneto, and the two south poles constitute a negative pole, hence their alternating current.

I think this should be corrected in your columns, as it will mislead those not familiar with magnetism, and those who might be saving that part as instruction in replacing the magnets on their Ford cars.

ROBERT L. WHITCOMB.

Memphis, Tenn. Supt. Memphis Assembling Plant.

The "Nevada" and the "Queen Elizabeth"

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in the recent discussion as to the offensive and defensive qualities of the 25-knot dreadnoughts of the "Queen Elizabeth" type and our "Nevada" type. The information given us in the SCIENTIFIC AMERICAN is not sufficient to enable one to determine which of the two types will prove the more effective all-around ships. I believe, however, if it were possible to obtain the full details showing displacement, fuel carrying capacity, kind of fuel, speed, radius of action, armor protection, torpedo defenses, etc., that the differences in favor of either ship would be immaterial.

To my mind, the prime requisite quality of a fighting ship of to-day is the ability to concentrate an irresistible attack. You have told us that the result of target practice in the British and American fleets was about the same, namely, forty per cent, until the fire control system was installed in the British ships, increasing their efficiency more than 50 per cent. This, to my mind, is where the British ship is superior to ours. You have told us that, in view of the increased efficiency by reason of this fire control system in the British ship, theoretically one round from said ship would either sink our "Pennsylvania" or so cripple her that she would have to retire from the scene of action. Consequently, there is only one conclusion I can come to; regardless of the fact that the "Nevada" could train two more guns than the British ship, she would be subjected to a preponderance of force that would be irresistible.

I would be much interested to learn more definitely showing a superiority in some way or another in our "Nevada" type sufficient to compensate us for the extra speed and the superior means of concentrating an attack in the British ship. R. DANIELS, JR.

New York city.

[By "fire control system" our correspondent, we think, must have in mind Admiral Scott's "director system," by which the target practice of the British fleet was improved over 100 per cent.—EDITOR.]

The Relation of the Ant, Leaf Roller and Spider With Bark Diseases

To the Editor of the SCIENTIFIC AMERICAN:

So many things have been attributed to the chestnut and other bark diseases that most people are apt to regard anything new respecting them as of little consequence. My experience, however, may throw a new light on this subject. It is a well known fact that the ant, aphide and the spider live together; this has been established by entomologists. Of the leaf roller, however, little seems to be known. Does the ant take care of this insect also, and what is his part in the disease?

I have found by carefully examining this insect and watching his development during the past summer, that the leaf roller is really the enemy of the tree. The way this is produced in very interesting. First, the spider and the ant take the leaf roller up the tree—in what numbers I do not know. But here the leaf roller begins his work, always guarded by the spider, and, strange as it may seem, this leaf roller lives entirely on the spider's web. This is done early in spring. The leaf roller makes a house for the aphide in the curled leaf of the chestnut which follows the ant, and is the first to appear in early spring; then come the others. I carefully put this leaf roller away in spring to develop. However, there was no development, and I was at sea to know what he was until one day in October I was looking for new evidence when I came across several of these leaf rollers. I tried to develop them again, and, to my surprise, I found out that the bottle I put these leaf rollers in was alive with small sucking insects which came from the leaf roller's body. Having discovered this, I compared them with the insects taken from the swelling of the tree and they proved to be the same in every case. These insects girdle the tree and go under the bark a distance of one and a half inches so that no spray will ever touch them or destroy them, and there is no hope for the tree unless these insects are kept from going up in spring. Once affected the tree is sure to die. That the ant is at the bottom of all this there seems to be no question. It is said that a live culture of this disease has been made. I think that this would be possible as the insects are like so much dust. We have F. R. Meyer's report that he has found this disease in China. If this is true, why does it not kill trees in China? Then come reports from India that the ants are killing the trees out there. If this is true, then why can the ant not kill trees in the United States of America? ARTHUR LAVER.

Bernardsville, N. J.

Bacterial Versus Inorganic Fertilizers

To the Editor of the SCIENTIFIC AMERICAN:

I read in your issue of January 24th an interesting letter by R. W. Davis of Moline, Ill., about "Bacterial versus Inorganic Fertilizers for the Soil." Mr. Davis takes issue with Mr. Cahill's statement that the artificial fixation of atmospheric nitrogen is one of the ten greatest inventions, especially in its relation to agriculture. He claims that this discovery is not important to agriculture because nitrogen is so easily obtained from the atmosphere through certain bacteria found on the roots of leguminous plants.

Now we all know that leguminous plants are a very fruitful source of nitrogen, but it is a very slow and a very hazardous process of obtaining it. If a leguminous crop could be grown as easily as weeds and with as much certainty, it would be another question. But this is not the case. It requires not only that the soil shall be in good mechanical condition, but good seed, and especially freedom from thawing and freezing, which destroys leguminous crops, especially alfalfa and clover.

Peas, beans and vetch planted in an orchard may supply the necessary nitrogen because fruit trees, as a rule, do not require as much nitrogen, and because they are feeding a good share of the time. They are permanent in the soil, but this is not true of the great family of hoed crops like corn, potatoes, cabbages, and small grains which mature inside of 120 days, and which require the bulk of their plant food within 60 days of the growing period. They must have nitrogen then or never.

Abroad and in the eastern part of this country they do not depend upon leguminous plants to supply the nitrogen for the staple crops, and never will. It is true that commercial fertilizers do not supply any considerable amount of organic matter, but this can be kept up by applications of stable manure and by growing catch crops or cover crops which can be plowed in from time to time.

From Mr. Davis' point of view we would not be justified in even utilizing the by-product nitrogen of our industries, the by-product nitrogen obtained from tankages, seed meals and fish waste. Is it not well to conserve this nitrogen and apply it to the soil, much of which has come out of the soil in the shape of crops which have been fed to animals? Also the enormous amount which is obtained in the shape of sulphate of ammonia from the soft coals which are used for coking purposes? Right under a good share of Illinois, in which Mr. Davis lives, there is a vast amount of nitrogen stored up, which some day will be utilized. Again, is it not well to utilize the thousands of horse-power going to waste in our great waterfalls, in creating electric energy with which to extract the nitrogen from the air, which in turn may be applied to the soil of Illinois to restore the nitrogen which has been exported in cereals all along the line of conservation.

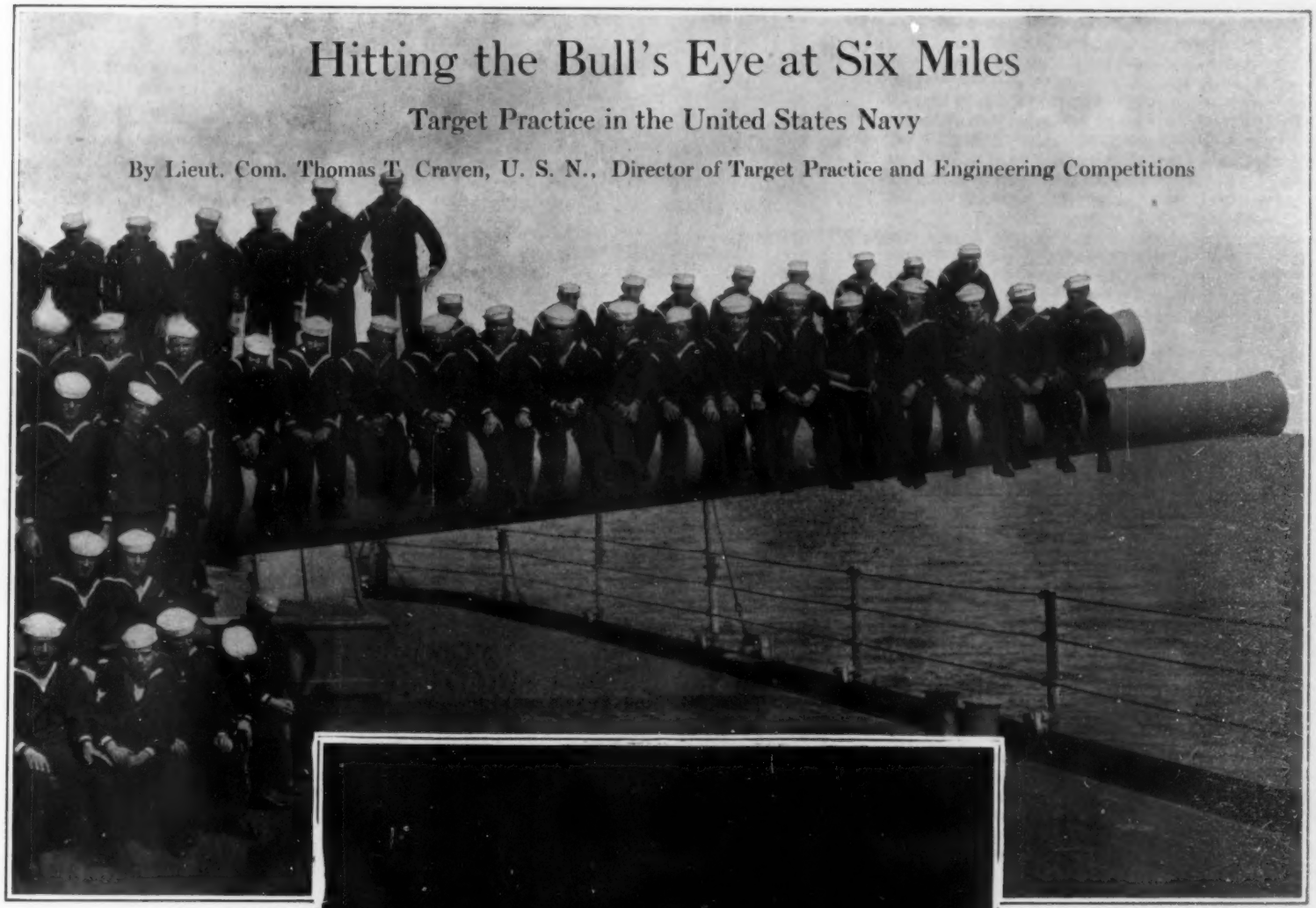
We are doing it now in the cyanamid of which you speak in your editorial comments, also in the nitrate of lime made in Norway; and it is confidently expected that we are going to do it by some catalytic process which may be either exothermic or endothermic. It is predicted that some day nitrogen will be as cheap as phosphorus and potash, but whether it is or not, the commercial farmer will not wait upon the slow and uncertain process of obtaining atmospheric nitrogen through leguminous crops; that is, if we may judge by the growth of the fertilizer industry, both in Europe and in this country in the past ten years.

Boston, Mass. W. H. BOWKER.

Hitting the Bull's Eye at Six Miles

Target Practice in the United States Navy

By Lieut. Com. Thomas T. Craven, U. S. N., Director of Target Practice and Engineering Competitions



Copyright by E. Muller.

Crew of turret on "North Dakota" which won the E (excellent) badge.

Copyright by E. Muller.

"Idaho" repelling torpedo attack at night.

SINCE the beginning of our history the United States has always led in the development and advance of gunnery; an exception being during that period which followed the Civil War, when our position changed from that of the leading naval power among the nations of the earth to that of one of the weakest. During that period of retrogression certain officers remained alive to the needs of the navy with respect to gunnery; but lack of appropriations and a flagging interest on the part of the country in naval matters, together with a deep-rooted conservatism on the part of individuals, stood in the way of progress.

A volume of considerable size was published in 1886 by the Navy Department on the "Target Practice of the Vessels on the North Atlantic Station," in which appears an effort to arouse the interest of the service in this matter. The volume lays down a course of training and "Rules for Fire." The principles given were essentially those of to-day. In the training recommended, "sub-caliber" was an important feature, a small arms rifle being attached to the larger piece and fired at a target at a reduced range. All sights were set together as ordered by the gunnery officer, and the guns were fired in succession or in salvo, the fire being controlled by an officer aloft.

But little real progress in promoting interest in gunnery was made for some years; a revival began, however, with the reconstruction of our navy; and while the marksmanship during the Spanish-American war did not compare with that of to-day, the gunnery of the few vessels then composing our battle fleet was probably not inferior to that of any navy of the world at that time.

The methods of training inaugurated by the well-known English officer, Admiral Sir Percy Scott, came to the notice of Capt. W. S. Sims, then a lieutenant of many years standing, about 1901. Sims put his shoulder to the wheel, and, supported directly by President Roosevelt, he overcame the departmental inertia and established for us a definite plan for gunnery work and training.

For years previous to this time target practice had been under the control of the Bureau of Ordnance, which was also charged with the design and supply of materials. An annual allowance of ammunition was authorized for target purposes, but no definite plans for practice were drawn up, and the ammunition for testing of materials and the training of crews was not always expended to the best advantage.

It is obvious that this system was defective and could not make for progress. The office of the inspector of target practice was established in 1901 under the Bureau of Navigation, and it remained there until taken over by the Division of Operations of the Fleet.

In 1896 a shot every three minutes from a turret gun, and one a minute from a six-inch weapon were considered to be satisfactory performances. A good "line shot," but "a little short" or "over," was very common and accepted as satisfactory comment at target practice. It has been calculated that we made about 3½ per cent of hits at the battle of Santiago at a range of about 3,000 yards. Most of these were with the smaller guns. How different the results of to-day, when more than three hits a minute are made from 12-inch guns, and eight are not infrequent from those of 6 inches in caliber. In the spring of 1911 the "San Marcos" was destroyed in a very short time by the guns of the "New Hampshire" firing at a range of about six miles. The percentage of hits was a sufficient demonstration of improvement and of the progress up to that time.

In the beginning of our modern development, and for some time after the establishment of the Target Practice Office, target firing was held in smooth water, at measured ranges. These conditions obtained for several years. Defects in material were discovered and

remedied, and officers and men were schooled in the elements and principles of gunnery.

In the practice of to-day realism is sought. Firing takes place under battle conditions, as closely as they may be simulated, and with regard for the casualties to be expected in battle. The elementary practice for the testing of gun's crews and pointers is held at a short range with a small target, just large enough to catch exactly aimed shots. This form of firing is primarily a competition between gun crews and pointers, and as a result of it the pointers are qualified.

When it is considered that a shell from a 12-inch gun, which leaves the piece with a velocity of 2,700 feet per second, at a battle range reaches a height of about a thousand feet, and strikes at an angle of approximately 9 degrees to the horizontal, it is not hard to understand the exactness with which the pointing and control must be accomplished in order to hit a moving target of small size. Loaded shells are not generally employed at target practice because of their expense. Cheaper projectiles of inferior metal, without bursting charges, are utilized for this purpose.

One of the numerous difficulties in obtaining skill in gunnery is that firing with smokeless powder causes erosion or a wearing away of the inner surface of the bore. This is most serious in the larger guns and necessitates the relining of these pieces from time to time, a procedure which costs about $10,000 and takes some months to complete. It has been found that the amount of this erosion, which like the muzzle velocity of the projectile, is a function of the weight of the powder used, and the consequent pressure, can be reduced by using smaller charges. For this reason reduced charges are generally employed at target practice in order to lengthen the life of the larger guns.

Having briefly outlined the recent development of gunnery and target practice, we will next take up the methods of training which are now employed and which have produced the results above described.

The members of the crew of United States naval vessels, as a class, are not equaled in intelligence by those of any other navy in the world. Young men are taken from every part of the country, provided they come up to the severe requirements for enlistment, and they are afforded the best of opportunities for advancement. A man with an honorable discharge from the Navy, if he sees fit to leave at the expiration of his term of service, has no trouble in obtaining a responsible position. A man who remains in the Navy, and attends to his duties, is sure of a promotion that compares very favorably with any that he may expect outside the service. Of course, he must put up with ship life and the restraints of discipline.

An important consideration in the promotion of efficiency has been the feature of competition. Gun crews on board ship are trained as carefully as any first-rate athletic team. Every detail and movement of the individual is carefully studied with the idea of eliminating interferences, and of producing team work which will develop a maximum of rapidity and accuracy of fire from each unit composing the battery.

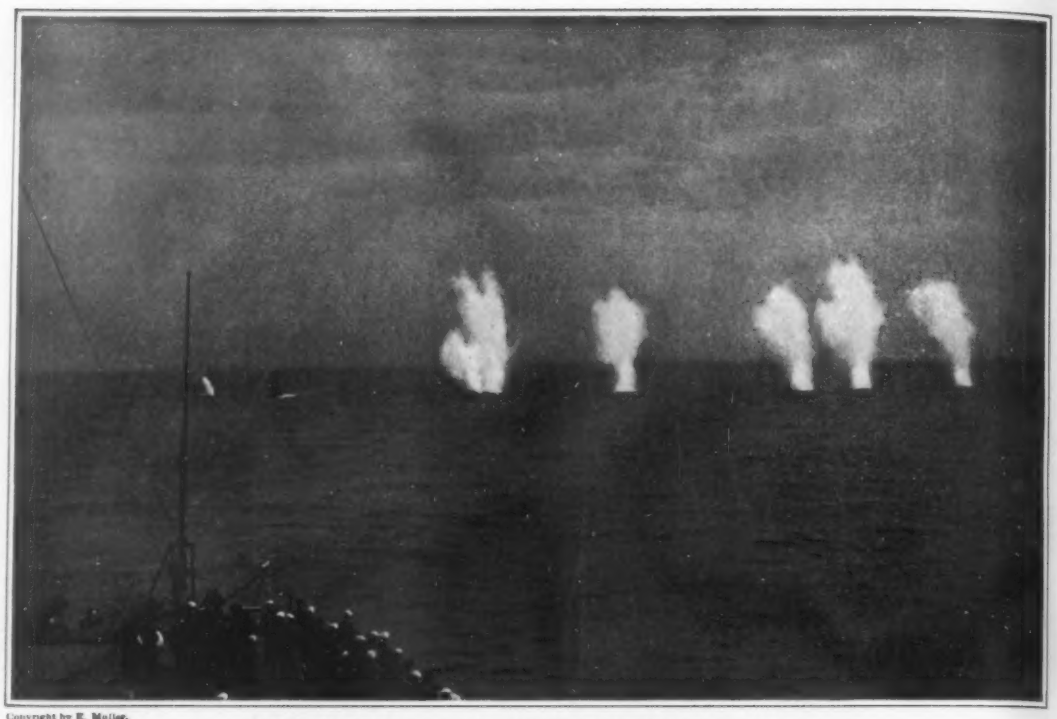
Loaders at other than turret guns are exercised at specially designed machines, where all the operations of loading may be performed without the excessive wearing of the mechanism that would be the case if actual guns were used for the purpose.

The gun pointers hold the positions of greatest importance. These men are selected because of their peculiar fitness for this work, which requires good eyesight, coolness, and nerve. In choosing candidates for the important duties of gun pointer, no qualities but these are taken into consideration. Pointers are carefully instructed in the manipulation of the piece and the duties of their station, and thoroughly drilled before their abilities are tested at elementary practice.

Pointers are divided into classes, and are given a gratuity each month in addition to their regular pay as shown in the following table:

Class	Duty	Additional monthly pay	
Heavy gun pointer	Pointers of guns of a caliber of 8-inch or above	1st class $10	2nd class $6
Intermediate	Pointers of guns from 4 to 8-inch caliber, inclusive	8	4
Secondary	Pointers of 1-pound to 3-inch caliber	4	2

The torpedo has steadily come to the front as a weapon. There are now torpedoes capable of running 11,000 yards at a speed of about 28 knots, and carrying over 200 pounds of high explosive. Torpedoes are carried on all classes of vessels, but are essentially the weapons of the destroyer, fast torpedo boat, and submarine. They are discharged from tubes either above or below the waterline. These projectiles are kept on straight, predetermined courses by means of gyroscopes. They are regulated in depth by means of a hydrostatic piston and pendulum, and are driven by engines operated by compressed air.



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Splash of a six-gun salvo, as seen from the towing ship.

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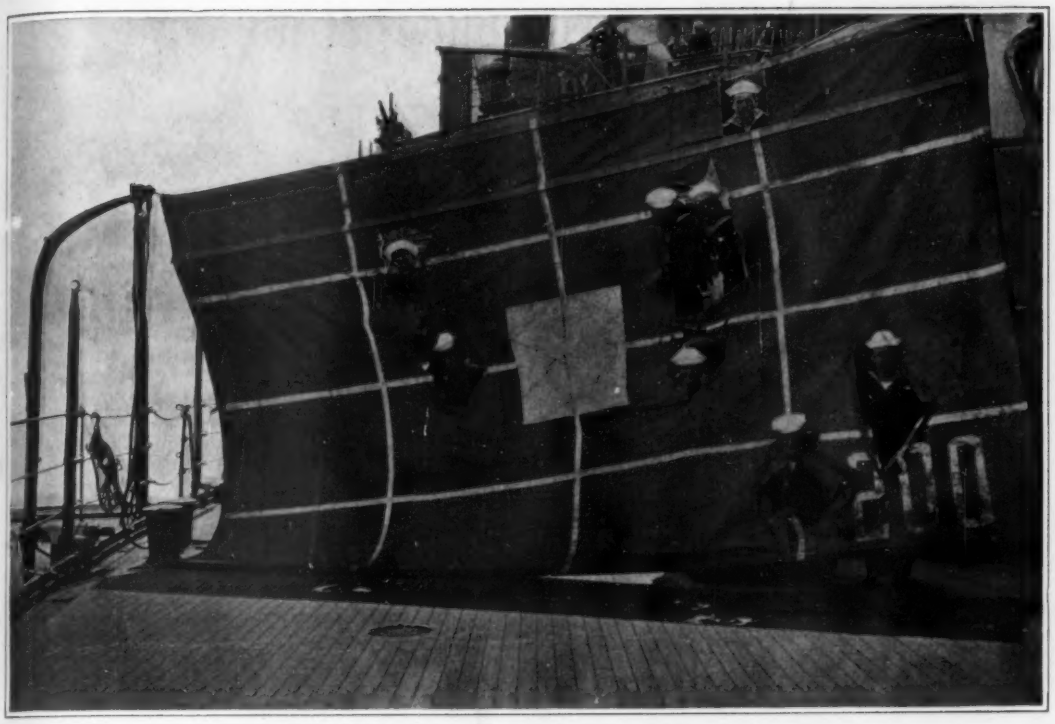
First Division maneuvering, as seen from the b



Good work by the gun pointers of the "South Carolina."

m the bridge of the "North Dakota."

The "war head" of a torpedo, containing the high explosive, and the nose for detonating the latter, are not used in exercise. This head is replaced by one filled with water which collapses on impact, without serious damage to the torpedo, and which may without injury be fired against the hull of a ship.

The torpedo men are usually given a special course of training and instruction at the torpedo school in Newport, where they are taught to care for the delicate mechanism of the torpedo and to make the adjustments necessary for successful running. Successful gun and torpedo crews are distinguished by a small block letter "E," which members thereof are authorized to wear on the sleeve for one year after the completion of the practice for which it has been awarded. Money prizes are also given to each man of gun and torpedo crews making the highest scores at target practice. A first prize amounts to $20, a second prize to $10, and a third prize to $5.

It is considered of importance that officers and men should have skill and knowledge of all the weapons which they may at any time be called upon to use, and special attention is given to the use of small arms in the Navy. When the record of an enlisted man shows him to be a sharpshooter or an expert with a small arm, he becomes marked at once as a trained man as well as probably one with nerve and sense of responsibility.

The large and well-equipped target range at Guantanamo, Cuba, is an excellent place for small arms work and for instruction and experience in landing operations. Each year vessels of the Atlantic fleet are required to land their men, and to conduct them through the small arms courses, and at the same time to exercise them in camping and in shore drills.

Cash prizes and medals are given for excellence with small arms and to the ship of the Atlantic, Pacific, and Asiatic fleets making the best performance for the year with these weapons is awarded the silver trophy for "small arms," which is held by that vessel for one year.

The combination of the scores of individual gun and torpedo crews at target practice is worked out, and the final standing of ships for the different practices are determined by the Department. At the end of the year the final combined scores for all forms of firing are determined for the different classes of vessels, and the trophies in gunnery are awarded.

These trophies are handsome bronze plaques on which are engraved the names of winning vessels. A trophy is carried by the leader of her class for one year. Letters of commendation are addressed to the officers deemed deserving of these at the close of the annual competition.

A competition is also conducted in engineering in the Navy, which has done much to produce economy in the expenditure of fuel, oils, etc., to promote efficiency, and to improve design.

Trophies similar to those awarded for gunnery are offered for excellence in this, and the members of the engineering department of the trophy winner are permitted to wear red "E's" on the sleeves of their uniforms similar to those authorized as a result of target practice to successful gun and torpedo crews.

Finally, the standings in the competition in engineering and in gunnery for each year are combined. Engineering is given a weight of 40 and gunnery of 60, and the multiples for what is termed "Battle Efficiency" are then determined for the different classes of vessels.

The leading vessel in "Battle Efficiency" of each of the different classes is awarded the right to fly the much prized pennant of red with a black ball for one year as a symbol of proficiency. It has been customary for the President to address a congratulatory letter to the captain of the battleship securing this prize, and for the Secretary of the Navy to similarly recognize the leading destroyer and submarine.

The above outlines the methods in vogue for the encouragement of competition between ships. The success of a vessel, in these competitions, is almost in every case directly measured by the spirit of the crew, and the pride and interest taken by them in the work of their ship, and this depends, almost entirely, on the attitude and intelligent zeal of the officers and the success with which they are able to co-ordinate and interest the men in accomplishing useful work.

The public accustomed to seeing the sailor about the streets of our seaports, seemingly idle when other men are busiest, does not always remember that this individual has been living with his work by night as well as by day for weeks and often months. Diversion and complete relaxation from his routine from time to time are necessary.

Because of the tremendous power and accuracy of modern ordnance, the effective use of their gun fire, on the part of one's opponents, in battle must be prevented. To accomplish this it is not only necessary to be able to hit at greater ranges than those at which an enemy is capable of hitting, but also to be able to make more hits than he under the difficult conditions imposed by a rough sea or bad weather, or with a rapidly changing range.

Eliminating the Flicker From the Moving Picture

A New System of Motion Picture Projection

By Joseph B. Baker

Motion picture projection rests upon the physiological phenomenon of "persistence of visual impression," whereby a momentary glimpse of a well-illuminated object prints an image on the retina which remains about one sixteenth of a second. In the ordinary motion picture method a rapidly succeeding series of snapshots are taken. These pictures are made one after another at the rate of sixteen per second upon a narrow strip of film, which is made to travel through the motion picture camera at the rate of one foot per second. There are therefore sixteen complete pictures in every foot of film. If the camera is pointed toward a scene in which is a falling weight, and the first picture shows the weight in the middle of the view, the second picture, taken one sixteenth of a second later, will show the weight in a new position slightly below, and the third will show a still further displacement of the weight, and so on. Say the weight has moved one foot between the instant of taking the first picture and the instant of taking the second picture. These two pictures will then show the beginning and the end of that one foot of movement, and there is nothing but a gap or blank in the interval between the pictures.

A thousand feet or more of this film may be taken of any moving scene. The projection on a screen to simulate the original scene is accomplished by making a positive transparency of the film negative and running the same through a specially contrived projection lantern, which throws an enlargement of the first picture upon the screen for an instant, then cuts off this image and one sixteenth of a second later throws the second picture on the screen, and so on. Before the impression of the first image has faded from the retina of the observer, the second image is impressed. The eye, retaining its impression of the falling weight as at one point in the general view and receiving an impression of the weight as at a new point, superposed upon the still lingering first impression, takes for granted the intermediate positions of the moving object. Thus it supplies, subjectively, the continuity of movement of the object—a continuity which is really quite lacking in the series of screen pictures. The action is just the same as viewing a field of running horses through a picket fence, as one travels along outside the fence. At a given instant the eyes have a clear view of the animated scene through a space between two pickets, the next instant the view is absolutely cut off by an interposing picket, then comes a new view through another space and another cut-off; but all the time the movements of the horses are seen apparently without a break. This system has its objectionable aspects. The film must move constantly so that it may not catch fire, and the "flicker" produced by the rapidly succeeding pictures produces eye strain. In the accompanying article an ingenious method is described, whereby it is sought to overcome these defects.—EDITOR.

THE ordinary motion picture apparatus demands a good deal of what might be termed continuity-preserving effort on the part of the human eye—just as catching spoken words reproduced by a phonograph or in a telephone receiver demands a good deal of the ear, in supplying with the imagination vocal sounds which are not fully reproduced by these instruments or not reproduced at all. (The field of mechanical devices is full of such partial accomplishments eked out by the accommodating human senses.) In the present system of motion picture projection, moreover, the rapidly recurring dark intervals between successive screen images and the eye-strain by variation of illumination (the so-called "flicker") have been objectionable to the observer. In the projecting machine, also, the intermittent movement of the film, the danger of fire from the heat to which the film is subjected during the instant it is held still for the projection of each picture, and the noise of operation, have been features that demanded radical improvement. A picture is projected for about 75 per cent of the picture interval of one sixteenth of a second; in the remaining 25 per cent of this interval the image is cut off by the blade of a revolving shutter, while the next picture is being brought into the focus of the lens; then No. 2 picture is projected. Part of the time a single, fixed image is on the screen; the rest of the time the illumination is absolutely cut off. The eye, staring at the screen, must use its faculty of persistence of impression to help fill in, so to speak, the abrupt dark interval and then suddenly receive a new shock of full illumination. The eye is bombarded with a series of impressions very sharply and definitely spaced apart by periods of absence of illumination on the screen. As in watching a prestidigitator we enjoy imagining an actual flight of the mysterious coin from the operator's palm to the table-top thirty feet away, so the eye "plays up" in the enormously more rapid and continuously exacting game of bridging the gaps of the motion picture film.

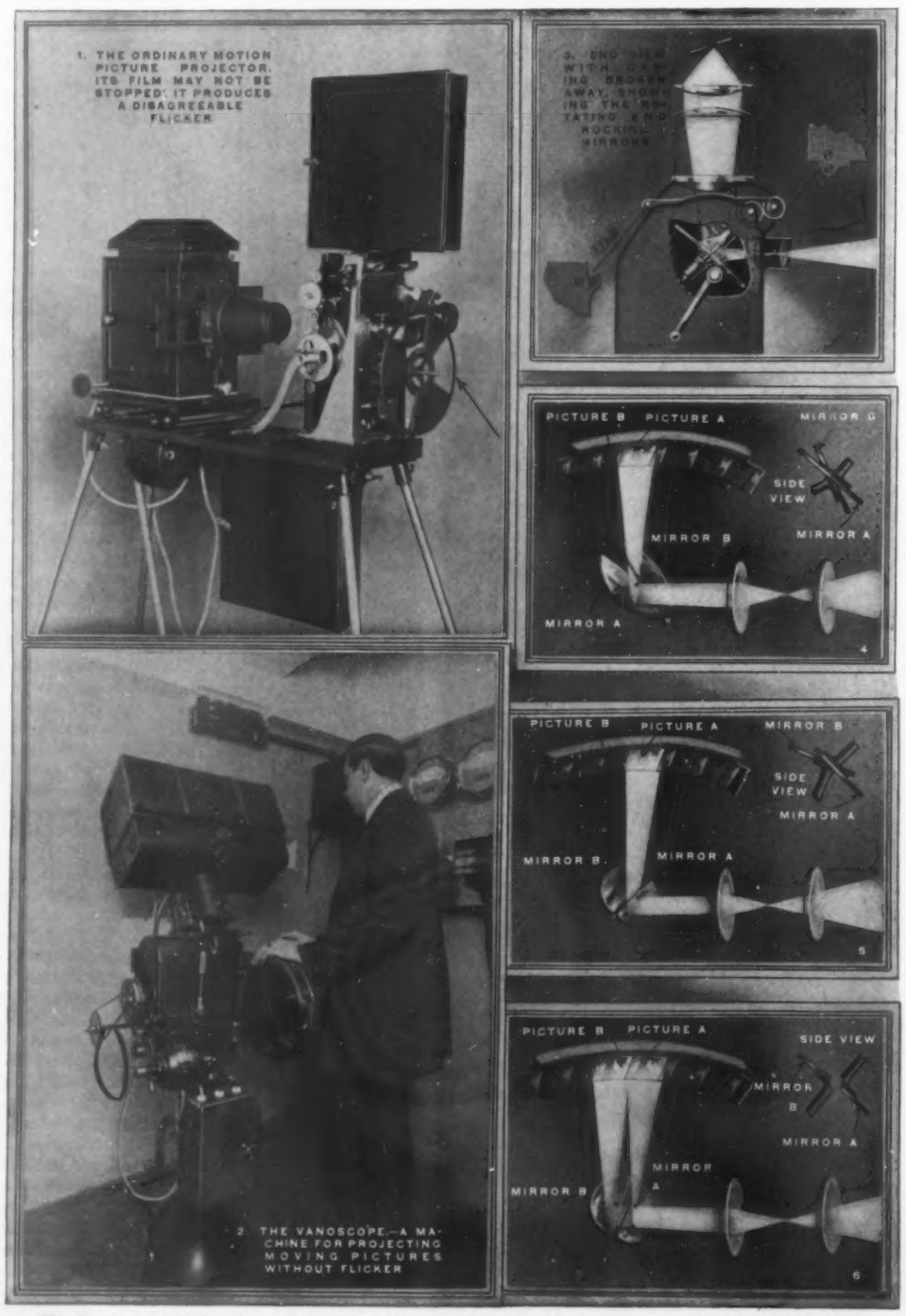
But in enduring the flicker the eye pays heavily for its self-imposed delusion. The resulting eye-strain is a disadvantage which the public puts up with, and seeks to counteract by watching the screen at a distance of at least twenty feet back within a rather narrow sector.

The fire danger may be estimated from the intense light necessary to obtain a continuous visual effect of good illumination in the screen picture notwithstanding the very large ratio of enlargement (about 1 to 97,000) and notwithstanding the intermittency of the actual illumination. It may be said that the film is always just on the verge of igniting. Hence the strict fire laws governing motion picture exhibitions.

A new machine called the vanoscope overcomes these imperfections in an apparatus giving a continuous visual impression from a steadily moving film. Its "moving picture" is not made up of abruptly succeeding fixed images separated by dark intervals, but of images which genuinely dissolve into one another without any interruption of the full illumination upon the screen. While the apparatus will project any standard film, the successive pictures may be taken at very much longer intervals if desired, that is, fewer per second than the limit of sixteen per second required for the present system, and they may be reproduced at the same slow rate on the screen—a feature invaluable for educational and motion study work. In fact, the normal speed is 8 per second, which gives very great reduction in the length of film. It is possible to put a "1,000-foot play" on 300 feet of film. "Travel ghost" is eliminated. The pictures are projected without being abruptly cut off by a shutter, but by actually "dissolving," one image decreasing in intensity of illumination simultaneously with the increase in illumination of the next succeeding image. As at an ordinary lantern-slide exhibition, where a view of Fujiyama, for example, melts into a view of a crowded street in Nagasaki, the eye has only to relinquish the outlines of one picture and take up the outlines of the next, with comparatively little physiological effort.

To obtain this result a new mechanical movement of four mirrors, being the four right-angle segments of a circle, which deliver the film image to the projecting lens, is employed. Each segment of this four-part reflector has conveyed to it a movement such as would be given by rotating it on an imaginary axis and simultaneously rocking it for-

(Concluded on page 151.)



Eliminating the flicker from the moving picture. A series of pictures that show how it is done.

Where and How Radium is Obtained

The American Supply of the Most Precious Substance in the World

By John L. Cochrane

THE wonderful radium which is exciting so much comment these days because of its reported curative properties, especially in the instance of superficial cancer, is obtained from the minerals carnotite, pitchblende and also autunite. The popular belief has been, until recently, that the chief source of radium is the mineral pitchblende, especially that obtained from the mines now under the control of the Austrian government, at Joachimenthal, Bohemia. Outside of the ore in Austria, the only pitchblende deposits of any size are those in Gilpin County, Colorado, from which some thirty tons, more or less, have been procured since the mineral became valuable as a source of radium. The most important source of radium is the carnotite ore and the greatest known field of this ore is in the Paradox Valley of Colorado and Utah. There is a little carnotite in South Australia and in Russian Turkestan, but the supply of carnotite in the Paradox Valley is so great as to lead scientists to make the statement that the United States practically has a monopoly of the radium-bearing ores of the entire world. The autunite deposits of Portugal and South Australia are unimportant.

In order to aid prospectors in their search for radium-bearing ores and to enlighten persons all over the country who had a faint suspicion that their rear yards contained the precious substance, the National Bureau of Mines but recently issued the following:

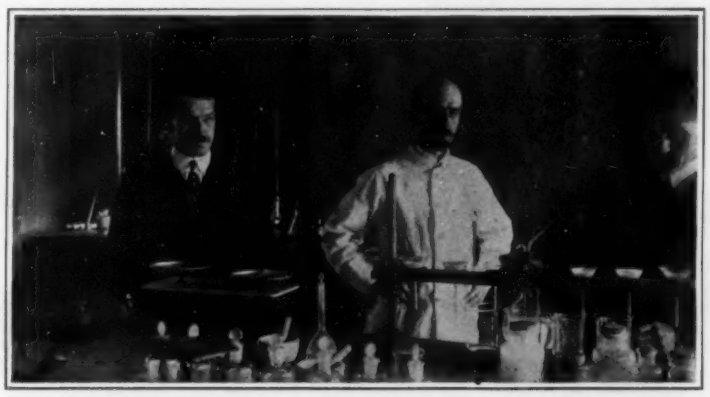
"Radium is found with uranium minerals only. Wherever uranium exists, radium is also found in the mineral; and where there is no uranium, radium has never been found. Uranium and therefore radium are found in this country in carnotite and its associated minerals, and in pitchblende. Carnotite is a lemon-yellow mineral, usually found in pockets of sandstone deposits. The mineral may be in the form of light yellow specks disseminated through the sandstone, or as yellow incrustations in the cracks of the sandstone; or may be more or less massive, associated with blue, black, or brown vanadium ores.

"Pitchblende is a hard, blue-black ore that looks something like magnetite, but is heavier. It is found in pockets and veins in igneous rocks. This mineral is not nearly as widely distributed as carnotite. Occasionally it is found associated with an orange mineral called gummite."

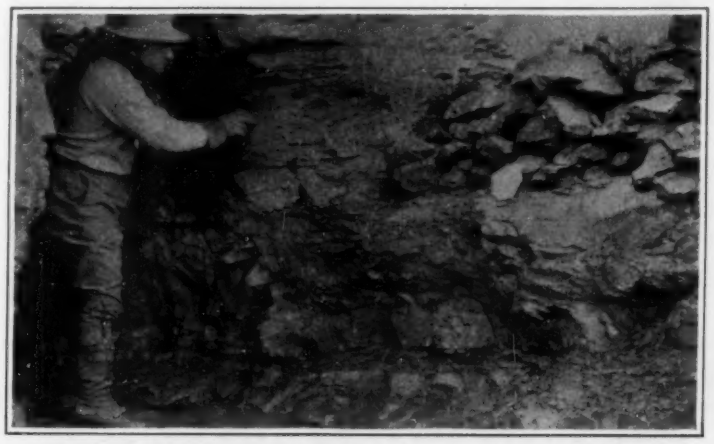
Although, until recently, the manufacture of radium from carnotite has been carried on almost wholly in France and Germany, the American ores having been shipped in great quantities, there appears no good reason why our American carnotite should not be treated at home. Carnotite is much more easily treated than pitchblende and the essential features of methods for its chemical treatment are well known, although much of the mechanical detail of operation has been kept secret. As the mechanical requirements, however, are those which any well grounded chemical engineer should be able to solve, there seems to be no reason why any of our carnotite ores should be shipped abroad, even at two or three times the present market price of the material. As regards the principles involved, the methods have advanced little beyond the original method published by Debierne.

Radium-bearing carnotite bags ready for shipment.

Nearly all American carnotite is sent to Europe for treatment. Now that we are beginning to evince some interest in our radium ores, perhaps we may soon treat carnotite ourselves.



From left to right—Dr. Karl Kithil, Dr. Richard B. Moore, chemists in the Bureau of Mines Laboratory at Denver, Colorado. Dr. Moore is in charge of the work of extracting radium from carnotite.



Miner showing carnotite in place, Paradox Valley, Colorado.

The manufacture of radium from carnotite is a long, tedious, laborious chemical process, complicated in the extreme by great difficulties in separating the radium from many foreign elements.

How Radium is Reduced.

The manufacture of radium from carnotite is a long, tedious, laborious chemical process, complicated in the extreme by the great difficulties encountered in separating the various foreign elements in the carnotite from the radium. The process has been likened to the method used in the purification of the table salt in every day use. The salt is placed in solution and the impurities driven off by crystallization. This, however, is a child's work in comparison to the extraction of radium from carnotite. The carnotite is placed in solution, and step by step the various other elements are reduced in quantity through the process of crystallization, each step leaving the radium freer from its associated impurities. The methods for extracting the radium from carnotite are best described by an eminent chemist in the following words:

"The most important operations in the working up of radium-containing materials are the solution of the materials, consisting usually of insoluble sulphates, and the separation of the halogen salts of the alkaline earth group in a pure state, followed by their fractional crystallization. The first operation is usually effected by vigorous boiling with sodium carbonate solution, filtering and washing free from sulphate. This is the well known reaction studied dynamically by Guldberg and Waage, whereby an equilibrium is attained between the two pairs of soluble and insoluble sulphates and carbonates. Naturally the greater the excess of sodium carbonate the larger the proportion of insoluble sulphate converted into insoluble carbonate. In this operation it is advisable not to wash at once with water, but with sodium carbonate solution until most of the sulphates are removed, as thereby the reconversion of the carbonates back into insoluble sulphates is largely prevented. In dealing with crude materials—for example, the radium-containing residues from pitchblende—it is often advantageous to precede this operation by a similar one, using sodium hydrate solution containing a little carbonate, which dissolves part of the lead and silica present. The carbonates, washed free from sulphates, are treated with pure hydrochloric acid, which dissolves the alkaline earths, including radium. From the solution the latter may be precipitated as sulphates by sulphuric acid and reconverted back into carbonates as before, or sometimes more conveniently they may be precipitated directly as chlorides by saturating the solution with hydrogen chloride. This is a very elegant method of great utility in the laboratory, for the most probable impurities, chlorides of lead, iron, calcium, etc., remain in solution and only the barium and radium chloride are precipitated, practically in the pure state, ready for fractionation."

The National Bureau of Mines, at the suggestion of Dr. Joseph A. Holmes, established a laboratory at Denver, Col., two years ago for an investigation of the rare ores and immediately plunged into a method for the extraction of radium from the carnotite. Dr. Richard B. Moore and Karl Kithil, in charge of the laboratory, as the result of their work, declare that the simplest way to extract uranium, vanadium and radium from carnotite is to treat the ore or concentrate directly with boiling concentrated nitric or muriatic acid. Even the vanadium and silica combinations can be decomposed by boiling with these acids for an hour, nitric acid giving the better results. They found that carnotite itself is soluble in cold dilute hydrochloric or nitric acid. The practicability of such a process, they say, depends upon its cost and the possibility of readily recovering the radium.

At the time the Bureau of Mines began its labors in Denver, no radium was being manufactured in the United States. The carnotite ores were being shipped to Europe at an alarming rate and at a price in no measure commensurate with their value. The ores are still being shipped, but all of it is not going out of the country. At least two American concerns are making radium and one has already placed some on the market, but it is understood that the output of this concern, for some time to come, will go to Europe. That the extraction of radium is apparently a very profitable business is seen in the assertion of the chemists of the Bureau of Mines. Messrs. Moore and Kithil say that while the cost varies in different places, being governed by the cost of labor, chemicals, freight, etc., $20 per milligramme is probably a maximum cost in Europe for extracting radium from carnotite ores. When it is considered that radium is selling for $120 a milligramme, the wide margin of profit can easily be seen.

An important development as a result of the investigations of the Bureau of Mines has been the establishment of the National Radium Institute, with Dr. Howard A. Kelly of Johns Hopkins Hospital, Baltimore, as president, and James Douglas of New York as one of the incorporators. This institute has obtained the right to mine the carnotite ores on twenty-seven different claims in the Paradox Valley for a period of three years. A mill for the concentration of the ores and the extraction of radium is now being built in Denver. The institute has been formed for the special purpose of procuring enough radium to conduct extensive experiments in radium therapy with special reference to curing cancer. The extraction of the radium from the carnotite ores will be made by the Bureau of Mines for the Institute.

Less Than Two Grammes of Radium in United States.

There are certain facts to be borne in mind in regard to the radium situation, and the first and most important is that there are less than two grammes of radium in the entire United States at the present time. In the entire world, the supply is estimated at 30 grammes, and the great bulk of this came from American ores. It is stated on authority that not more than two American physicians have enough radium to use in the treatment of cancer. One of these is Dr. Kelly, the famous Baltimore surgeon, and he has more than half the entire supply in the entire country. He declares that instead of one gramme, he should have ten grammes.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A New Governor for Motor Vehicle Control

AN automatic governor is necessary for power vehicles not only on the score of prolonging the life of the motor, but also on the score of fuel economy.

But the automatic governors employed to-day do not assist the driver in the operation of the vehicle. They are merely speed limiters, and as such they may be divided into two classes, namely: governors which limit the motor speed directly, through curtailing the gas flow, and indirectly the vehicle speed; and governors which limit the vehicle speed directly through its influence on the motor, and indirectly the motor speed, through curtailing the gas supply, or by grounding the ignition. The non-ignition method, owing to the many and serious objections to it, can have only a very limited application, and will not be considered here.

It is conceded generally that these governors have serious limitations, yet it has been the policy of many designers to provide their vehicles with them on the assumption that the disadvantages resulting from omitting them would be far more serious than those from using them.

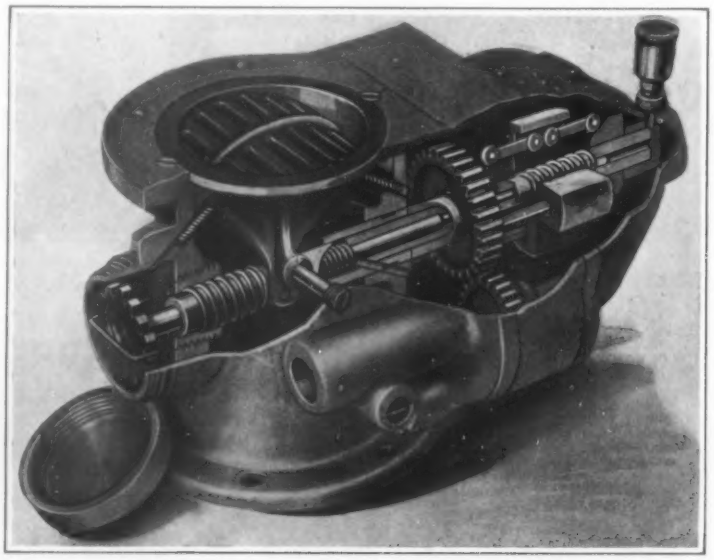
The requirements of an efficient motor vehicle governor are that it accomplish at least five things; first, it should provide a positive control of the maximum speed of the motor, at all times, whether running idle or under load; second, it should permit of different maximum motor speeds for the different gears, and it should confine these speeds, so far as possible, considering the power requirements for the different gears, to within that zone of motor speeds corresponding to the highest motor efficiency; third, it should do this through a mechanism capable of simple and accurate adjustment whereby the maximum speed of the motor, and the maximum speed of the vehicle, may be raised or lowered at will to suit the varying conditions of service for which the vehicle has been designed, or provided; fourth, it should provide a valve mechanism, free from fluttering tendencies, which will effectively and economically feed the gas mixture to the motor only in such amounts as may be needed to develop and to maintain the desired power, and no more; and, fifth, all of these functions should be included in a mechanism of such simple design and substantial construction as to be fool-proof and tamper-proof, and capable of being locked, or sealed.

The need of such a governor has been keenly felt in the vehicle industry, and yet no progress seems to have been made in evolving such a design until the recent advent of what is known as the duplex governor, which is now undergoing some severe trials by several of the large commercial vehicle manufacturers, and the reports concerning which are said to be very satisfactory.

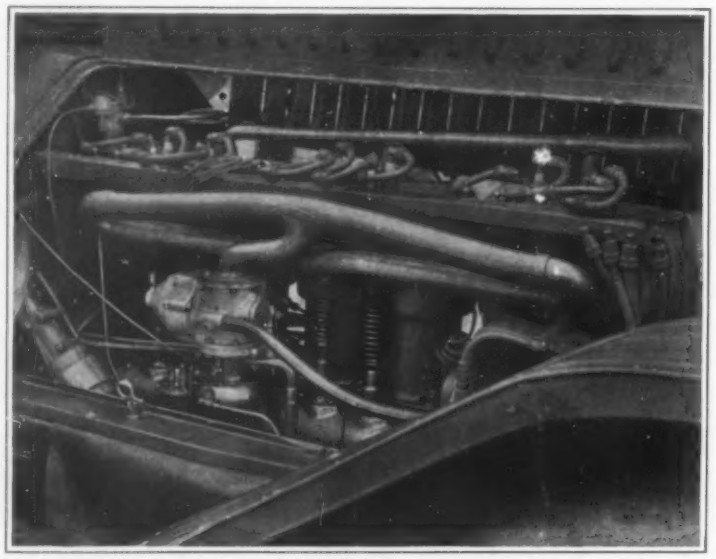
This governor was designed on the principle of a dual actuating influence. This double influence consists of a motor influence, as to its speed, which is imparted to the governor, and a vehicle influence, as to its speed, which is also imparted to the governor. The motor speed may be conveyed from the timing gears, magneto shaft, etc., and the vehicle speed from the propellor-shaft, or jack-shaft. The conveying speed means consists of a one quarter inch, sixteen strand, steel cable revolving in a hard fiber, or metallic casing. The centrifugal member, valve member, and adjusting member are all consolidated into a single unit within an inclosing shell which is interposed between the carbureter and the intake manifold of the motor, in such a manner that the entire gas supply must pass through the valve.

On each side of the valve chamber provision is made for the insertion of a speed terminal, one conveying to the governor a proportionate vehicle speed, and the other conveying a proportionate motor speed. Within the governor there are two automatically acting one-way clutches, the floating members of which consist of gears in mesh with a third gear mounted on the centrifugal governor spindle. These clutches are so designed as to impart to the centrifugal member that of the two speeds which is the higher. With the motor running idle the motor speed will actuate the governor, and the motor is always under governor control. When the vehicle is in motion, and is being propelled by the motor on high gears, the speed imparted to the governor by the vehicle will be the higher speed and will govern the motor, whereas on low gears the motor speed will be the higher and will govern the motor.

The governing valve employed is a grid valve of special construction and is said to be entirely new in the industry. It consists of a fixed part set into the upper part of the valve chamber and provided with elongated slots having flaring walls from its under surface outward. Below this fixed part a movable part, provided with a corresponding series of slots having flaring walls from its upper surface downward, has an arc movement along the line of the minor axes of the slots, or across them, and is supported by means of a substantial bearing. The maximum travel of this movable part is less than one eighth of an inch; yet that small travel effects all degrees of aperture between full open and full closed valve. When the openings of the rigid part coincide with the openings of the movable part the valve is open, and when the bars of the rigid part cover the openings of the movable part, and *vice versa*, the valve is closed. The two parts of the valve have a ground fit. The movable part is held in open position by means of spring pressure, and its possible motion, in both directions, is limited by suitable adjusting screws.



A new type of gasoline engine governor.



How the governor is applied to an automobile engine.

The influence of the centrifugal member, as a result of the speeds imparted to it, is to develop a pressure sufficient to overcome the spring pressure tending to hold the valve in its open position, and to close the valve. As soon as this pressure is removed the movable valve part is released, and returns to its full open position. The adjustment factor is constant for all speeds. The increase of the centrifugal pressure, as the square of the speed increases, is balanced by a spring pressure tending to return the centrifugal weights to their negative position, plus the spring pressure of the movable valve part. The working combination between the centrifugal member and movable valve part is influenced by the adjusting screw. The locking yoke may be removed and the hand-wheel turned to the right, in which case the possible vehicle and motor speeds are reduced, and if turned to the left, they are increased. This results from the lengthening or shortening of the valve stem, and thus increasing or decreasing the required travel of a floating collar, carried by the centrifugal member, to influence the position of the valve.

It is claimed that the construction of the valve and its actuating influence are such as to free it from all vibration; its movable part is balanced, and its center of gravity lies within its center of support. The openings of the valve parts, when superimposed, are so designed as to constitute elongated venturi with a view to wire-pulling all of the gas passing through the valve, and for the further purpose, through the flare of the walls of the openings, to establish slight cross currents in the gas flow to promote the better commingling of its ingredients.

The centrifugal member revolves in a chamber entirely separated from the gas chamber, and in an oil bath. This chamber contains all of the moving parts of the unit, except the valve and yoke parts in the valve chamber, which have a maximum movement of less than one eighth of an inch. A screw cap is provided to cover the adjusting means, which may be locked or sealed.

Among other vehicles the governor was applied to a five-ton truck. Before the application a careful service run of the truck was made across country with a gross load of 19,000 pounds, and without a governor. The motor control was by hand and pedal with a very careful effort made to maintain a speed of 9.5 miles per hour, and not to exceed it. A record was kept of the other factors of the performance. The governor was applied and a corresponding, and in every way similar, run was made over the same roads and for the same distance with the result that it was done in 21 per cent less time, with an average speed of 8.85 miles per hour, as against an average of 7.5 miles per hour of the previous run; with 20 per cent less gasoline; with an average reduction of 10 per cent of radiator temperature; and 5 per cent less piston travel. Of the hills on which it was necessary to drop below third gear without the governor, 70 per cent were made on third gear, proving thereby that the automatic control was to that extent more efficient than the personal control. This resulted largely from the fact that the best of drivers will misjudge their grade and road resistances and will not work for any length of time at a high efficiency, whereas with the automatic control the vehicle is kept up to its best performance, and when it reaches a grade it has its maximum momentum, the motor is turning over at its maximum speed for that gear, the motor is being given just as much gas as it will take to maintain that speed, and without either starving or loading-up tendencies.

When the governor was applied to a pleasure vehicle (a six-cylinder roadster), in which the maximum vehicle speed is limited to thirty miles per hour and the maximum motor speed to 1,000 revolutions per minute, it was demonstrated that the maximum vehicle speed can be maintained on fourth and third gears, on which gears the vehicle controls the motor, and on the other gears a reduced, but relatively high speed can be maintained with almost 100 per cent increase of power

(Concluded on page 152.)

DELCO

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Three Epoch Making Steps in Automobile Development

The automobile of today is an almost perfected machine.

Powerful, speedy, splendid in its ability to do things—yet under such complete control that it is as easy to operate as an electric carriage.

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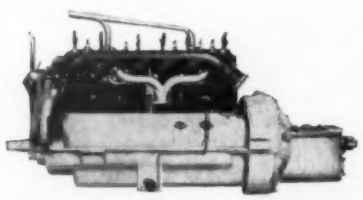
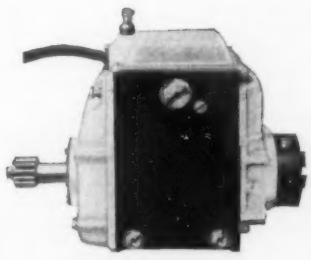


THE GASOLENE MOTOR—We might have had motor cars without the gasolene engine. Steam or electricity might have served as the motive power—but they would not have been the splendid high powered, flexible machines that have so revolutionized our ideas of time and distance. The gasolene engine is fundamental to the automobile as we know it today.

THE PNEUMATIC TIRE—But even with the gasolene engine simplified and perfected to its highest efficiency its usefulness would have been sadly curtailed had not the pneumatic tire come to make its full development possible. The pneumatic tire, too, is fundamental to the twentieth century automobile.



THE DELCO SYSTEM—The Delco System has been the refining influence in the development of the gasolene car. It has eliminated the crudities of the crank and of hand lighted lamps. It has provided an ignition that is thoroughly dependable under all sorts of operating conditions. It has furnished an always available auxiliary power that removes the danger of accident when the engine stalls unexpectedly in a tight place. It has immeasurably broadened the scope of the automobile by making it so easy and safe to operate that almost any one can readily master it.

The Delco System is the pioneer in the Electric cranking and lighting field—and today two-thirds of all the electrically cranked cars in existence are Delco equipped. Verify this last statement for yourself—count the electrically equipped cars you see on the street.

The Dayton Engineering Laboratories Company, Dayton, Ohio

"But Doctor—I can't get away now for a Rest"

WHEN the nerves cry out—and when the bonds of business, home ties, or the expense of travel, hold the sufferer to the beaten path—a good tonic may bring timely, restorative help.

The very aid the nerves need to *rebuild* them, to give back the health and courage drained by work or worry, is brought to them by Sanatogen. And this nourishing help comes in a form that makes it natural and easy for the depleted cells of the system to absorb it.

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Sanatogen is sold by good druggists everywhere, in three sizes, from $1.00.

Prof. C. A. Ewald, of Berlin University, Doctor honoris causa University of Maryland, states in his contribution on "Typhus abdominalis":

"I can say that I have used Sanatogen in a great number of cases (that is, in those disturbances of metabolism which were mainly of a nervous or neurasthenic origin) and have obtained excellent results."

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The Hope-Jones Orchestra

(Concluded from page 137.)

There is also an armature disk valve *M* made of soft Swedish charcoal iron that rests normally upon a hollowed metal cap *N*, which is perforated by two crescent shaped openings. Directly above this disk there is an electro magnet *Z* fixed rigidly into a metal plate.

Under normal conditions the weight of the armature disk valve causes it to remain seated upon the raised faces of the cap seat *N* in such a manner that the compressed air contained in the wind chest *B* passes between the poles of the electro magnet, fills the cavity in the cap seat *N* and then passes, by means of the passage *P*, into the primary pneumatic bellows or motor *Q*. When the musician depresses one of the keys on his keyboard an electric contact is established and a current at about 10 volts pressure flows through the flexible cable connecting his keyboard with the instrument proper, and by energizing the electro magnet, raises the armature disk valve *M* so that no more compressed air can flow from the wind chest *B* into the passage *P*. Hence, the compressed air already in the primary bellows *Q* escapes to the atmosphere through the passage *P*. This results in the collapse of the pneumatic motor *E* and the consequent lifting of the valve spindle *H* (as described before), producing sound in the organ pipe *J*.

In the above mechanism the areas of the various channels, valves, pneumatic motors, etc., bear a carefully calculated relation one to the other, with the result that a seemingly incredible speed of action is obtained. Tests by means of revolving toothed wheels have shown that an organ pipe may be made to give its full tone and assume silence no less than 300 times per second.

The initial pressure admitted to the pipe for a small fraction of a second is considerably greater than the pressure of the compressed air in the chest *B*, thus giving what the inventor describes as a "pneumatic blow" to start the speech of his pipes. This wonderfully rapid action has entirely altered the organ as a musical instrument. It places the musician in such intimate touch with his pipes that he is, within certain bounds, able to produce accents and many other variations. Every pipe and other tone-producer in the instrument is equipped with an electro-pneumatic lever described above, and under its control.

The keys which the musician operates are made very short and as light as is practicable, with the object of eliminating inertia. Upon pressing the key, contact is made between a bar of silver attached to the key and a number of very fine silver wires secured to the key frame. Through the contact thus made, the electric current passes to an electro-pneumatic relay which closes from 10 to 30 similar silver contacts, according to the size of the instrument. The current then passes through a multiple switch to the electro-pneumatic lever controlling its appropriate pipe.

The multiple switch last referred to can be closed or opened by means of one of the stop keys arranged in a semi-circle just below the music desk.

Each one of the key boards upon which the musician plays, including the large one operated by his feet, is fitted with a double touch. The key descends in the ordinary manner to its usual depth; it then meets a small lever held firmly in place by a spring already under tension. If the musician presses one of his keys with greatly increased force, this small lever and spring will be overcome and the key will fall another sixteenth of an inch, thereby giving an additional second touch contact to cause some other pipe or tone producer to give a different quality of tone.

All the keys are also fitted with a pizzicato touch which can be switched on and off by the musician. When brought into operation the current, supplied through one of the silver contacts below the keys, flows for an instant to the electro-pneumatic lever controlling an additional set of pipes or other tone producers.

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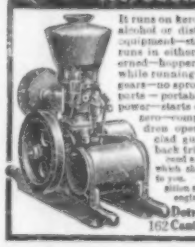
20 Reasons Why You Should Investigate the SANDOW Kerosene Stationary ENGINE



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SECURITY amid Death and Destruction

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Here is a private cigar, made up specially for me, banded with my monogram.

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I send the cigars by Parcel Post, so supplies are very convenient. The price is $5 per hundred—$2.60 for 50—charges paid. That price is not far from my cost.

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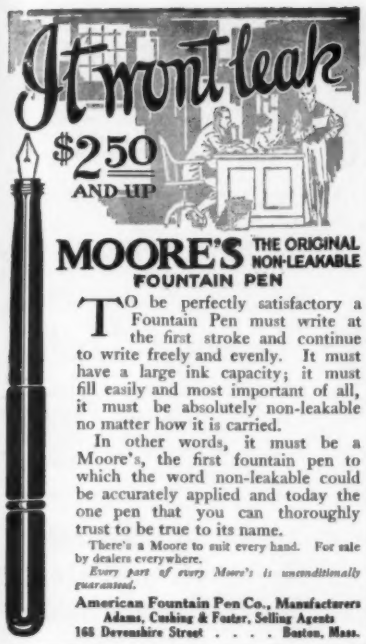
J. ROGERS WARNER
801 Lockwood Building, Buffalo, N Y

(36)



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Eliminating the Flicker from the Moving Picture

(*Concluded from page 146.*)

ward at one half the angular velocity at which the film travels. The annexed drawings of a vanoscope apparatus of earlier design, equipped with two half-circle instead of four quarter-circle mirrors, show the succession of events by perspective and side views. In the perspective view of Fig. 1 the picture *A* is being projected by mirror *A* through the lens to the screens; the side view shows the position of the mirrors (exaggerated for clearness) when picture *A* is being projected solely by mirror *A*. Fig. 2 shows the conditions after the film has been moved forward a short distance, and mirror *A* has been rotated to a point where it is about to pass out of the field of light; and mirror *A* has also been rocked forward, as shown in the side view, at one half the angular velocity of the film, so that the picture as projected has been continued as a stationary image on the screen. Fig. 3 shows picture *A* after the film has moved still farther forward and mirror *A* has been rotated to a position partly out of the light field. The whole of the picture is still being projected upon the screen by this mirror, but the image is only partially as *brilliant* as it was when the mirror was fully exposed to the light; and picture *B* is now also being projected, with partial illumination, by mirror *B*, and is gradually increasing in brilliancy in proportion as the illumination from mirror *A* is decreasing. The actual image on the screen is therefore now made up of both picture *A* and picture *B*. It is in fact a composite of them both, the pair making together 100 per cent of illumination in a dissolving picture. As one mirror segment moves out of the field the lessened illumination is compensated for by the increased illumination of the next mirror segment moving into the field.

Whereas in the ordinary motion picture apparatus the illusion of continuity is a physiological effect, in the new system this illusion is largely produced as an optical effect in the apparatus. Persistence of visual impression is not so severely taxed, and in the co-operation of machine and eye the machine does a much greater part of the work than it does in the old system. The picture appears to "stand out" from the screen, owing to the heightening of verisimilitude by the presence of two dissolving images.

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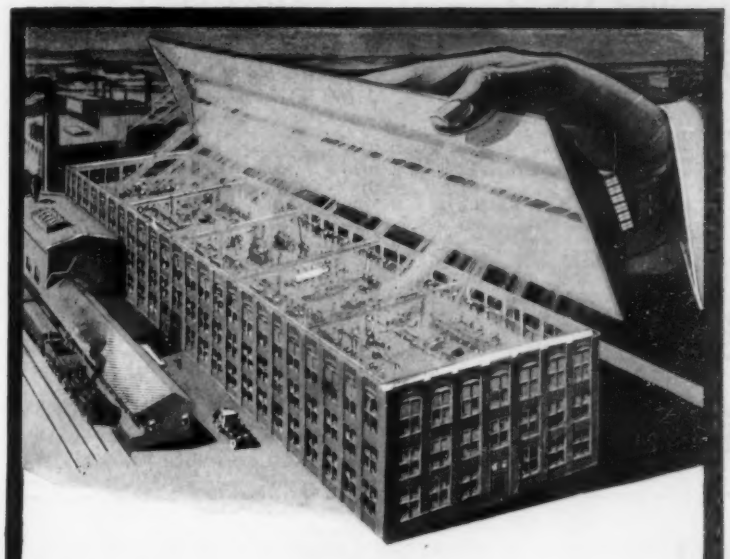

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Governor for Motor Vehicles

(*Concluded from page 148.*)

output of the motor above its possible output on high gear.

It is claimed by the inventor, as the result of actual practice both on the pleasure car and on heavy vehicles, that the maximum variation in speed, with throttle wide open, both on climbing and descending normal grades, within the power and compression limits of their respective motors, will fall within a plus or minus five per cent. Where the vehicle speed is low, as in the case of a commercial vehicle, it is recommended that the car be speeded to its desired maximum and then run on full throttle under governor control. With pleasure vehicles on open highways this plan is also feasible. It makes the driving of the car simpler and frees the driver from a great deal of nervous tension and strain which is very trying in a full day's operation.

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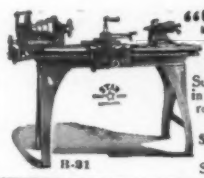
Platinum Deposits

IMPORTANT deposits of platinum have been discovered at Wenden, Westphalia, in a region previously well known for its deposits of other metals. A territory of 500 acres has been examined and the borings from nine different drill holes show the presence of from 0.9 to 1.9 troy ounces of platinum per cubic yard, which is said to be a higher content than in the Russian deposits of this valuable metal. The actual extent of the German deposits is not even vaguely known as yet, but Mr. Thomas H. Norton, American consul at Chemnitz, who has made a report on this discovery, thinks that the platinum market is likely to be profoundly affected. It appears that the metal was found alloyed with silver, and therefore would have escaped detection in an ordinary ore analysis, as in this state it is dissolved by nitric acid. The consul (who is a chemical expert) suggests that the German discovery will lead to a revision of rock analysis in other parts of the world, with the possible result of platinum being found to be a much commoner metal than it is now supposed to be. The diminishing supply of platinum has long been a serious economic problem. The present annual production is about 13,250 pounds, 95 per cent of which comes from Russia. The demand far exceeds the supply, and the price has advanced since 1892 from $89 to $488 per troy pound. The unique value of platinum depends upon the fact that its coefficient of expansion is the same as that of glass and of the materials used by dentists for artificial teeth. About one-third of the world's supply is used in the electro-technical industries, and another one third in dentistry.

Beet Sugar Industry in Great Britain

THE question of establishing this industry in the British Isles has been agitated for a quarter of a century without any tangible results until recently. Under the auspices of the British Beet Sugar Council, organized in 1910, experimental crops were grown so successfully that at the end of 1911 a large company was formed, which erected a factory at Cantley, Norfolk, and contracted for the produce of 3,366 acres. In 1913, about 4,500 acres were under cultivation for the company, and the crop was about 60,000 tons. Experienced beet farm hands have been imported from Holland to aid and instruct the English laborers. The new industry is therefore now well established in Great Britain, where it bids fair to modify materially the present economic organization of the rural districts.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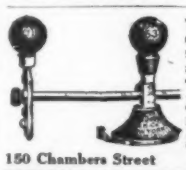
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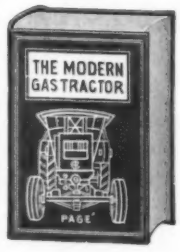

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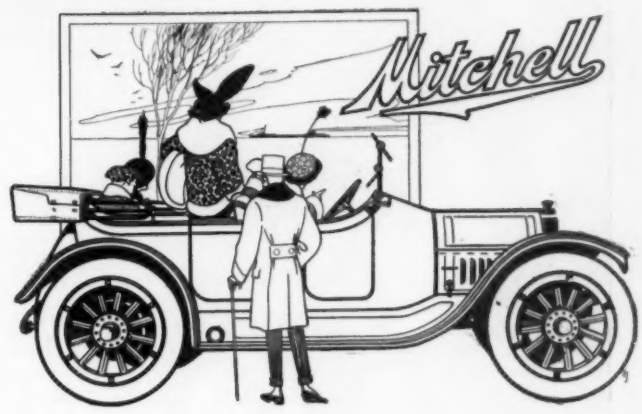

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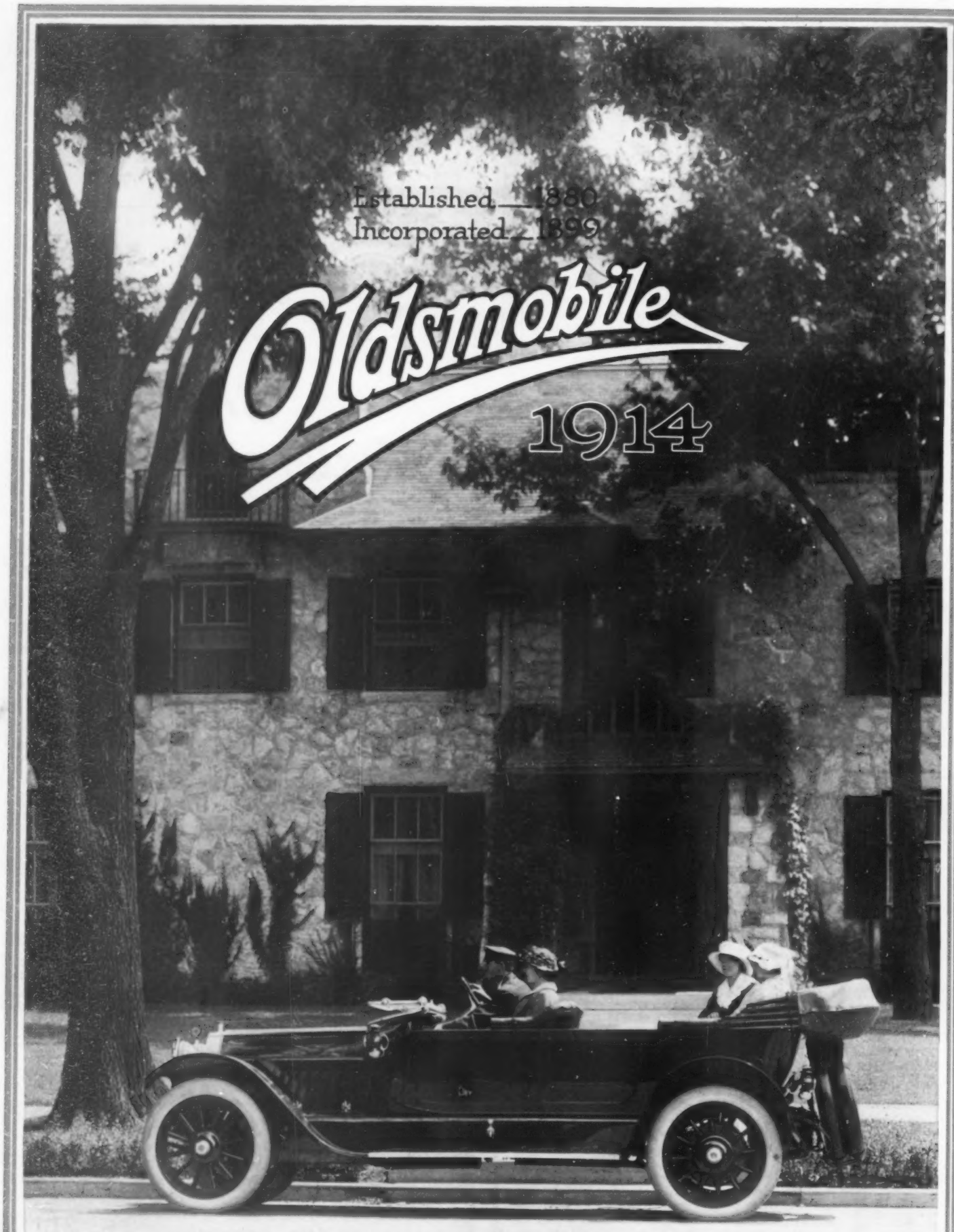

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